Development of British naval gunnery 1815-53.

MacMillan, D F

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D.F. MacMillan

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There had been little chan e in ritish naval ordnance between the mid-sixteenth and late ei hteenth centuries. The adoption of the carronade in 1779, however, to eth r with adv ces in gun casting and po der milling after 1783, provided safer, more dependable weapons, well suited to the close-quarters, rapid-fire en agements preferred by the Royal Navy. Brilliantly successful against the French Republic and Empire, these weapons and tactics proved inadequate against the lon -guns and long-range skills of the Americans.

British losses in ship co bat during the War of 1812 caused European navies, including the Royal Navy, to adopt gunsights and vent tubes, gunnery manuals and intensive gunnery training. They also adopted heavier ships capable of mounting more powerful ordnance, and attempted to standardize both ships and ordnance. During the 1820's Britain and France introduced uniform calibre of maximum effect, thus bringing the sailing ship of the line to its apogee in size and po er.

It was also during the twenties that steamers mounting shell guns first demonstrated their usefulness for warlike purposes. In 1829 the Admiralty commenced building war steam rs and ordered that they, together with ships of the line, receive shell guns.

The shell eventually revolutionized naval architecture; it revolutionized naval gunnery immedi tely. A gunnery school was established aboard H.M.S. _Excellent_ to provide seaman gunners capable of firing shells safely and accurately. _Excellent_ also served as an experimental depot. Thus not only did she train gunners, but she provided the navy with an unprecedented opportunity to study armament problems peculiar to naval service. By 1853 smooth-bore ordnance and smooth-bore gunnery had achieved something like perfection.

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Abbreviations

Add. MSS.	Additional Manuscripts, British Museum, London.
Adm.	Admiralty records and correspondence, Public Record Office, London.
C.H.R.	Canadian Historical Review.
D.N.B.	Dictionary of National Biography.
ELL/	Minto Papers, National Maritime Museum, Greenwich.
Ind.	Indexes under Adm.12 at the Public Record Office.
MLN/	Milne Pa ers, National Maritime Museum.
M.M.	Mariner's Mirror.
N.L.S.	National Library of Scotland, Edinburgh.
MSS.	Ordinary Manuscripts.
N.R.S.	Navy Records Society publications. See bibliography under various editors.
P.P.	Parli m ntary Papers, as numbered for the House of Commons series.
W.N.D.	Wellington, Duke of, ed., Disp tches, Correspondence and Memoranda of the Duke of Wellington (London, 1867-80).

PREFACE

My purpose in this thesis is to describe the development of British naval ordnance and naval gunnery between the years 1815 and 1853.

Many authors have pointed out the influence of the War of 1812 on the development of naval armaments; others, notably J.P. Baxter in The Introduction of the Ironclad Warship, and F.L. Robertson in The Evolution of Naval Armament, have discussed the influence of the adoption of shell guns on the development of naval architecture. But there has been no adequate account of the precise nature and extent of the American influence on British gunnery; neither has any close study been made of British research and experimentation on shells before or after their adoption in 1829. Practically nothing has been written on armaments developments between 1830 and 1853.

There is thus need for a straightforward narrative account of the improvements in naval ordnance and gunnery between 1815 and 1853. From this narrative conclusions will be drawn concerning the Admiralty's attitude towards innovation, and the manner in which development was carried out in a period of peace and economic restraint.

There are many people to whom I am indebted for assistance in the preparation of this thesis. I should like to thank the members of The Imperial Order Daughters of the Empire for the financial support they gave me during two years of research. I would like to express my appreciation to Professor G.S. Graham of King's College for the help and encouragement he gave me while writing these chapters. I am also indebted to Mr. N. Bridges for giving me access to the surviving personal papers of his ancestor, General Sir Howard Douglas, and to Professor Michael Lewis for his suggestions concerning the last two chapters of this work.

Most of the research has been carried out at the Public Records office and I should like to thank the directors and staff for their help. I am also appreciative of the services of the staffs at the British Museum, the National Maritime Museum, and the Admiralty Library. Finally, I thank Mrs. Jane Barton for the conscientious and able manner in which she has carried out a difficult typing chore.

INTRODUCTION

Infinitesimal as naval progress in the first half of the nineteenth century might appear compared with that of the second, the increasing tempo of warship and armament development between 1815 and 1853 was nevertheless unmistakable. During these years the shell system was adopted and steam machinery introduced and greatly improved. By the time of the Crimean War many ships of every class in the navy mounted shell guns and were fitted with steam engines. By that time, too, the Royal Navy had replaced the completely unsophisticated attitude toward gunnery, commonly held before 1812, with a scientific and precise approach. Smooth-bore ordnance, and the ship of the line with which this ordnance is generally associated, were alike brought to their highest development in size and power.

Despite these innovations and the considerable amount of study and experimentation necessary to bring them about, contemporary writers give the impression that the years under study comprised a period of cautious and reluctant experiment carried out by a succession of Admiralty Boards with a shared prejudice against progress. This was simply not the case. The passing of the ships and tactics and armaments that had defeated Napoleon was undoubtedly observed with reluctance by many, and even ignored by the diehards; the Admiralty, generally speaking, was more hard-headed. Every new device, every improved device and many suggested devices, whether discovered in England or abroad, were subjected to official consideration, and if promising, to official experiment. Every ten years a special review was held of armament equipment in service or suggested for service, during which the best material was selected and introduced gradually into naval service.

The Royal Navy thus had a definite policy regarding the introduction of improvements into service. With few exceptions it was strictly adhered to, and as the following chapters reveal, it served Britain well during these years of unprecedented armament development. For between 1815 and 1853 many changes took place in naval artillery and gunnery, whereas during the long war against the French Republic and Empire there had been few innovations or improvements in naval armaments. Before the war there had been some slight improvement in the 1780's, and before then there had been very little development since the middle of the sixteenth century.

It was in the reign of Henry VIII that oared war galleys were finally abandoned for the gun-carrying, ocean-going sailing ship. The earliest of these ships were no more than platforms built to charge and grapple the enemy so that the soldiers aboard could engage in hand-to-hand fighting and board. Armament, too, was anti-personnel rather than anti-ship in nature. It consisted of large numbers - as many as 200 - of small, breech-loading guns firing projectiles of very little weight, and was intended to repel boarders.[1]

Early in Henry's reign, however, the potential broadside strength of great-ships was recognized. Heavy ordnance, usually in the form of bombards, became increasingly popular. Bombards were hollow cylinders constructed of longitudinal bars, commonly of wrought iron, clamped together by forcing red hot iron rings

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1. Much information on early naval ordnance is to be found in J.S. Corbett, Drake and the Tudor Navy (London, 1912), vol.I., pp. 1-59, 358-72; C. Ffoulkes, The Gun-Founders of England (Cambridge, 1937), passim; Fuller, J.F.C., Armament and History (London, 1946), pp. 90-96; M. Lewis, Armada Guns A comparative study of English and Spanish Armaments (London, 1961) passim.

over them. They were mounted in beds of solid timber and loaded from the breech which was another cylinder shaped to fit tightly into the barrel when wedged from the rear.

Guns other than bombards were at first imported from Italy and France. By 1512 this trade had largely ceased in favour of importing gun-founders from the same two countries; bronze guns were soon being cast at the Tower of London, and in 1543 cannon of cast iron were produced at Braxstead in the Weald of Kent. Cast guns were much stronger than the bombards assembled from wrought iron bars, and increased strength was given by casting them with a solid breech making it necessary to load from the muzzle. Cast upon a core until the early eighteenth century, drills imported from Switzerland made it possible to cast the gun solid and ream out smooth and precise bores.

Muzzle-loading guns cast in brass or iron rapidly superceded breech-loaders, and by the end of Henry's reign more than forty different patterns and sizes of gun were being cast in England, both in bronze and iron, which were not greatly inferior to those used by Nelson at Trafalgar.[1] In an attempt to standardize armaments, this unwieldy number was in 1559 reduced to six classes of heavy ordnance with several varieties of lighter guns.

Broadly speaking, the largest great-ships of Elizabeth I, such as the Triumph, carried 40 to 50 heavy cannon and a secondary armament of 25 to 30 light breech-loading guns. This excess in numbers and weight of armament strained Tudor ships, causing them to sail badly and to leak. After a temporary reduction in weight under Elizabeth 1, a Commission of Reform in 1618 upheld the use of heavy artillery for naval service. By this time most of the gun models that were to serve the Royal Navy throughout the seventeenth, eighteenth and much of the nineteenth centuries had appeared. The bastard cannon, demi-cannon and cannon-petro, the culverin and demi-culverin had merely changed their identity to 42-, 32-, 24-, 18- and 9-pdrs.

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1. There were a number of different methods of classifying ships' guns at this period. For one example see Corbett, I. 364-65, 372.

And although broadside strength was slightly increased in 1716, and again in 1733, by replacing some guns with the next higher calibre, there were no alterations in the actual guns.[1]

Not until the last quarter of the eighteenth century was there any significant change or improvement in naval ordnance.

1. See dm.7/677, "Establishment of Ordnance", Orders in Council of 6 July 1716 and 21 Feb. 1733.

Chapter One

ARMAMENT LESSONS OF 1779 AND 1812

The last quarter of the eighteenth century was a period of great improvement in the quality of British sea artillery. Advances in gun casting and powder milling, together with the adoption of the carronade, provided safe, dependable weapons, well suited to the close-quarters, rapid-fire engagements preferred by the Royal Navy. Brilliantly successful against the French Republic and Empire, these weapons and tactics were to prove inadequate against the heavy guns and long-range skill of the Americans. American successes in ship combat during the War of 1812 prompted other navies to adopt more powerful ships and armaments, to strive for the skill and scientific precision that long-range combat required, and by these activities to commence the nineteenth century's armaments race.

During the Seven Years War the Royal Navy had shattered the neglected fleets of France and Spain. In the peace that followed 1763 these powers rebuilt their navies, while the British, largely for economic reasons, carried on with existing ships.

This policy played some part in Britain's loss of the seas during the American Revolution; for the patched-up 50- and 64-gun ships of 1763 were opposed in 1778 by European counterparts mounting 64 and 78 guns.[1]

After 1783, considerable effort was made to bring British ships up to European standards. The 50-gun ship was discontinued, the ubiquitous 64 of the eighteenth century was deemed too small to serve in the line, and by 1793 it had become clear that a similar fate awaited the 74.[2] But not only were ships capable of fighting those of France and Spain laid down after 1783; a close examination of naval armaments was also undertaken.

In 1779, Captain Sir William Congreve, later Superintendent of the Royal Laboratory, inspected ship's gunpowder at Plymouth. He found only four serviceable barrels in the whole division.

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1. G.S. Graham, Empire of the North Atlantic the Maritime Struggle for North America (Toronto, 1950), pp. 202-03. R.G. Albion, Forests and Sea Power. The Timber Problem of the Royal Navy: 1652-1862 (Harvard, 1926), pp. 390-91. Sir William Bowles, Pamphlets on Naval Subjects (London, 1854), pp.27-33. A.T. Mahan, The Influence of Sea Power upon History 1660-1783 (Boston, 1890), pp.259-60, 331-32, 336-47, 428, 493-94.

2. Bowles, 27-33. Sir Charles Napier, The Navy: Its Past and Present State (London, 1851), pp.64-66. H.J. Paixhans, Nouvelle Force Maritime (Paris, 1822), pp. 55-56.

The following year the newly appointed Inspector of Artillery, Sir Thomas Blomefield, discovered that, like gunpowder, the navy's artillery "had degenerated to the lowest point in quality." Bursting guns were frequent, and would have been more frequent, reported Blomefield, had "the roguery of contractors in gunpowder ... not kept pace with the roguery of contractors in guns."[1]

Immediately the war was over, resolute steps were taken to improve the quality of armaments. Congreve, who had revealed the poor quality of gunpowder, was appointed Superintendent of the Royal Laboratory in 1783. Under his direction government powder mills were established at Feversham in 1784, and at Waltham Abbey in 1788. This effectively removed production from the hands of private contractors and gave Congreve the opportunity

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1. E.W. Lloyd and A.G. Hadcock, Artillery: Its Progress and Present Position (Portsmouth, 1893), p. 24. F.L. Robertson, The Evolution of Naval Armament (London, 1921), pp. 85-86 and notes.

to manufacture his own improved gunpowders.[1]

The casting of heavy guns, on the other hand, was left largely to private firms. The Ordnance Department, responsible for supplying weapons to all the services, insisted however that contractors improve the quality of their weapons. In 1797 an inspector of foundary guns was appointed to enforce the rigorous proving procedure to be undergone by every heavy gun supplied by contract. The high standards imposed forced contractors to improve their casting, and to introduce new machinery that would bring the surfaces of bore and shot "nearer mathematical precision."[2]

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1. Sir Howard Douglas, A Treatise on Naval Gunnery (1st ed., London, 1820), pp. 194, 201-02, 210-211. F.C.P. Dupin, View of the History and Actual State of the Military Force of Great Britain, translated by "An Officer" (London, 1822), ii. 82-85. R. Glover, Peninsular Preparations: The Reform of the British Army 1795-1809 (Cambridge, 1963) pp. 67-68, 86. O.F.G. Hogg, The Royal Arsenal its Background, Origin and Subsequent History (Oxford, 1963), i. 481. See also W.O.47/110, fos. 530, 570, and Sir William Congreve, A Statement of the Facts relative to the Savings which have arisen from Manufacturing Gunpowder at the Royal Powder Mills; and of the Improvements which have been made in its Strength and Durability since the year 1783 (London, 1811), especially pp. 11, 25-28.

2. Dupin, Military Force, ii. 239, 287-91.

Improvements in guns and gunpowder were accompanied by improvements in carriages. In 1803 the Royal Carriage Department was established. Although its greatest triumph lay in providing the best field artillery of the day, it also brought improved quality to naval gun carriages.[1] In 1810, the Second in Command of this department, Colonel William Cuppage, wrote glowingly of "the great improvements in Gun Powder, in the purity and perfection of Brass and Iron Ordnance, and in the economy and uniformity in the preparation of Gun Carriages.[2]

The Ordnance Department had thus succeeded in providing the navy with safe and dependable weapons. The fear of guns bursting or misfiring, a fear that added to the demoralization of other fleets, practically disappeared from the Royal Navy. This increased power, accuracy and dependability, resulting in increased confidence, gave the British an incalculable advantage over other navies.[3]

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1. Ibid. ii. 287-314. Hogg, Arsenal, i. 507-10.
2. Add. MSS. 37889, W. Cuppage to W. Windham, 6 April 1810.
3. Clowes, vi. 28. Douglas, 1st ed. pp. 7-8.

Yet it is well to recall with Mahan that it was the "efficient tactical bearing of ... improvements in the materiel of war" that was paramount.[1] There can be little doubt that the British used their improved weapons efficiently during the Napoleonic Wars, or that their celebrated close-quarters, rapid-fire tactics reflected in some measure the navy's confidence in its weapons. But to an increasing degree British tactics reflected the growing dependency on a new weapon particularly suited to close-quarters action. This was the carronade. The first major innovation in sea artillery for two centuries, the carronade became the weapon most responsible for establishing the close-quarters pattern of naval warfare in Europe during the Napoleonic Wars.

Designed in 1774 by General Robert Melville, the carronade has been described as a "very short, light, carriage gun of relatively large bore, made to take a standard size of long-gun shot and project it, by means of a small charge of powder, against

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1. Mahan, The Influence of Sea Power upon History, p. 495.

an enemy at close range."[1] It was first produced in 1779 by the Carron Company of Scotland as a defensive weapon for merchantmen unable to rely upon the Royal Navy for convoy protection. It was well suited for this purpose. A 32-pdr. carronade, for example, fired the same projectile as a 32-pdr. gun; yet the gun was nine feet six inches long and weighed 55 cwt., whereas the carronade measured four feet and weighed only 17 cwt. The gun required a crew of fourteen to operate it, the carronade a crew of five.[2]

These qualities were invaluable in small, crowded merchant vessels where the great sacrifice in range was of small importance. A merchantman's objective was to avoid combat, and reducing armament weight through the use of carronades enhanced the possibility of escape by permitting faster sailing. Moreover, almost certain destruction awaited the privateer that

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1. Robertson, p. 125-26. Much of the information on the carronade is taken from Robertson, Chapter Five. See also P. Cowburn, The Warship in History (London, 1966), pp. 149-50.

2. For comparative weights of other calibres see W.O.44/498, Royal Arsenal Return of Sea Guns, 29 March 1813.

did manage to pull alongside. For the carronade was much more destructive within its range than was the same calibre long-gun.

This surprising superiority resulted from the small carronade charge projecting the regulation shot at low velocity. It had long been known that maximum effect was gained when the projectile had just sufficient velocity to penetrate the target. Thus 24-pdr. shot was more effective when fired from carronades than from a high velocity gun, owing to the fact that in high velocity penetration, a clean, easily repaired hole resulted. The low velocity projectile, on the other hand, smashed large, jagged holes, and scattered splinters inboard. Before carronades this splintering effect of low velocity fire had been achieved by double-shotting long-guns. The single impact of the carronade shot was much greater than that of double-shotting, and much greater accuracy was possible.[1]

The carronade was therefore particularly well suited to the

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1. Robertson, pp. 128-29. Paixhans, Nouvelle Force, p. 12, note. J.A. Dahlgren, Shells and Shell-Guns (Philadelphia, 1857), pp. 8-13.

needs of merchantmen. But naval officers disagreed on its suitability as a naval weapon. Many disliked it because the flash from its short barrel set fire to the ports and rigging. They also pointed out the tendency of these weapons to break their beds and to upset, owing to the lightness of their construction. But those who opposed the carronade did so primarily on its limited ranging power. These were the captains who preferred to retain the tactical maneuverability provided by long-guns. They did not relish having a large part of their armaments rendered impotent by the long-guns of an enemy skilfully keeping beyond carronade range.[1]

There were, on the other hand, those officers who contended that the great majority of decisive combats were settled within easy carronade range. History afforded much supporting evidence

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1. For the controversy over the carronade, see Douglas, 3rd. ed., p. 148. Paixhans, <u>Nouvelle Force</u>, pp. 18-19. Robertson, pp. 128-34. F.C.P. Dupin, <u>Voyages dans La Grande-Bretagne</u> (Paris, 1820-24), ii. ii. 103-07. T.F. Simmons, <u>Ideas as to the Effect of Heavy Ordnance Directed Against and Applied by Ships of War, etc.</u> (London, 1837), pp. 2-5.

for this contention. While admitting the carronade's various defects, its supporters were convinced that these were more than compensated for by the weapon's destructiveness.

It was further argued that a ship armed entirely with carronades could serve well provided she sailed quickly enough to escape unequal combat. This idea was put to the test. An old 44-gun frigate, the Rainbow, was rearmed with large calibre carronades that practically quadrupled her broadside weight of metal. In 1782 she sighted the French frigate Hébé, lured her within range, and silenced her with one massive broadside. The supporters of the carronade appeared vindicated.[1]

A more realistic assessment of the new weapon was provided at the Battle of the Saints, also in 1782. During the inconclusive engagement of 9 April, the French Second in Command, De Vaudreuil, deliberately fought from a point just beyond carronade range. On 12 April Rodney succeeded in bringing the action to close quarters and to a successful conclusion.

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1. Robertson, p. 134. Dahgren, Shell-Guns, p. 11 and notes.

De Vaudreuil believed it was the carronade that had "so badly crippled" his fleet. But if De Vaudreuil correctly assessed the weapon's effectiveness at close-range, his tactics of April 9 had certainly revealed its limitations at long-range.[1]

The carronade had nevertheless proved a valuable addition to the fleet. The Admiralty took immediate steps to arm the quarter decks and forecastles of all 36- and 38-gun frigates with 24-pdr. carronades.[2] On the average this class of frigate wisely retained three guns to one carronade. Many of the faster small frigates and lesser vessels, however, received, as had the Rainbow, an exclusively carronade armament. By the turn of the century every class of ship mounted a large proportion of the light weapon.[3]

The proliferation of carronades to all rates was most marked in the last decade of the eighteenth century. It was not until

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1. Robertson, p. 134. Mahan, pp. 494-95.

2. Adm.7/677, "Establishments of Ordnance", Admiralty to the Master General of the Ordnance, 16 July 1779, and Admiralty Order of 17 Dec. 1779.

3. Robertson, p. 131.

1779, for example, that they were mounted on the quarter decks and forecastles of ships of the line. This was in part owing to the comparative cheapness of the carronade, and to the desirability of reducing both the number of crew and weight of armament carried so high above the waterline.[1] But the carronade proliferated largely because it proved so effective against the French and Spanish. In fact, the weapon originally intended as defensive armament for merchant ships became, in the hands of the Royal Navy, the most effective offensive armament of the day.

This surprising fact resulted from the definite pattern of naval warfare that had developed in Europe throughout the eighteenth century. This pattern was largely determined by the strategy of France. The succession of humiliations inflicted on her fleet by Britain in the first half of the eighteenth century convinced France that she could not be supreme both as a maritime and continental power. During the Seven Years War,

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1. Adm.7/677, Admiralty Orders of 25 Nov. 1782, 17 March 1797, 4 June 1799, 24 June and 4 Oct. 1805. Adm.160/150, Proportion Tables of H.M. Ships, 1781-1828, fo. 12.

therefore, the French changed their strategy from grand war to cruising war. In other words, rather than fight fleet actions, the new role of France's Navy was to attack commerce and inferior enemy warships. French Admiral Grivel described the strategy:

> If two maritime powers are at strife, the one that has the fewest ships must always avoid doubtful engagements; it must run only those risks necessary for carrying out its missions, avoid action by maneuvering, or at worst, if forced to engage, ensure itself of favourable conditions.[1]

British strategy was exactly opposite to that of France. The objective of the Royal Navy was to control the seas by destroying enemy fleets. In this manner Britain inevitably became the pursuer, France the pursued, and maritime warfare between the two came to consist largely of British ships pressing the reluctant French for action. Even during the American Revolution the French clung to their defensive strategy despite opportunities to engage inferior British forces. The British too, outnumbered and often outclassed, fought a

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1. Mahan, pp. 289-90. On French strategy see also Ibid. pp. 371-72, 376, 386; Douglas, 3rd. ed., pp. 614-16.

largely defensive war. At that point, in 1779, the Admiralty introduced the carronade.

It was at the battle of the Saints, described above, that the carronade proved itself, not as a defensive, but as an offensive weapon. During the wars against the French Republic and Empire, British ships continued to press for close action, but now when close-quarters was attained, murderous carronade fire hastened the conclusion of the combat.

The French did not adopt the carronade until 1790. Of such poor construction that they endangered their crews, their adoption was not calculated to embolden the demoralized French sailors.[1] The British found Napoleon's ships easy game, a fact that increased their disdain for the enemy. Nelson was not the only British officer to regard the French with a "contemptuous confidence that characterized ... to some extent his tactics toward them."[2] He was, however, the most brilliant practitioner of these tactics. The "Nelson touch" became synonomous with daring, even reckless approach to close-quarters. The carronade

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1. Dupin, Voyages, ii. i. 71, ii. ii. 104-06. See also Graham, Empire of the North Atlantic, pp. 218-19.

2. Mahan, p. 506.

was particularly well suited to these tactics.[1]

Thus the "yard-arm tactics" long preferred by most British captains, and previously adopted when opportunity permitted, became practically obligatory under all circumstances. French demoralization and incompetence had seemingly proved "that no one can do wrong who lays his ship alongside an enemy."[2] British captains adhered slavishly to this maxim; through uninterrupted success from "being feebly opposed", the confidence of the Royal Navy in its armaments and tactics increased to the point of over-confidence after Trafalgar.[3]

In November 1811, the American frigate Constitution called at Spithead. She immediately attracted the attention of J. Wilson Croker, First Secretary of the Admiralty. More stoutly built than many 74-gun ships, the Constitution measured twenty

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1. Simmons, Effect, pp. 2-5. See also Michael Lewis, The Navy of Britain A Historical Portrait (London, 1949), pp.545-46.

2. Commander A.W. Jermingham, Remarks on the Means of Directing the Fire of Ships' Broadsides (London, 1851), p. 34.

3. Douglas, 3rd ed., p. 3.

feet lon er than a standard British frigate, opposed 24-pdr. guns to British 18-pdrs., and carried two hundred more crew. Croker fe red no ritish frigate could stand up to her in battle.[1]

While visiting Portsmouth, the First Secretary expressed his concern to Captain S.J. Pechell. Pechell, an experienced naval officer and gunnery expert whose opinion commanded respect, "vauntingly remark d th t he would take h r [the *Constitution*] in half an hour."[2] This attitude was sh red by Pechell's fellow officers on the North American station. They had observed the *Constitution*'s sister frigates *United States* and *President* at close hand, and eagerly sou ht an opportunity to fight them.[3]

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1. N.R.S. *Dillon*, ii. 182.

2. *Ibid*. Pechell (1785-1849) entered the n vy in 1796, serving most of his first ten years in th Channel and off the coast of France. He served on the North American station from 1807-14, and as Captain of Warren's flagship *San Domingo* and later *Sybille*, had a reputation as a stickler for good gunnery. An M.P. 1830 and 1833, Lord of the Admiralty, 1830-34, 1839-41. O'Byrne. D.N.B.

3. Sir W.L. Clowes, *The Royal Navy. A History from the Earliest Times to the Present* (London, 1903), vi. 37.

This opportunity materialized in June 1812, when President Madison declared war on Great Britain. In the event, Croker's fears were realized. Pechell's professed ability to capture an American frigate in thirty minutes did not extend to those officers engaging the United States and Constitution. During the first months of hostilities three British frigates, Guerrière, Macedonian and Java, were completely crushed by the two Americans in single-ship-combat.[1]

Captain Pechell's boast to Croker that he would capture an American super frigate in thirty minutes reflected the general British overconfidence. Yet Pechell was an authority on gunnery; he knew well that advances in British ordnance following 1783 made it superior to the armaments of all other navies, including the American.[2] Nor was he greatly impressed by the American long 24-pdr. guns. Frigates mounting this heavy armament had fallen to the Royal Navy in the past. In 1782 the South Carolina, formerly the French L'Indien, and carrying 36-pdrs., had been captured from the American colonists, as had the French 44's

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1. See below.
2. Douglas, 1st ed., 6-8. Dupin, Military Force, ii. 239.

Pomone, Egyptienne and Forté, all mounting 24-pdrs. The Forté fell to Sibyl, a standard British 38 mounting 18-pdr. guns, while the Pomone provided the model for such British frigates mounting 24-pdr. guns as Leopard and Endymion.[1]

Thus, not only was there evidence that 24-pdr. frigates were not invulnerable to those mounting 18-pdrs., but the British possessed more 24-pdr. frigates than did the Americans. Apart from those surrendered by the French and Dutch, and those built on the lines of the Pomone, the Admiralty in 1794 had commenced cutting down such unsatisfactory 74-gun ships as the Anson, Magnanime, Indefatigable and Barham to 40-gun frigates mounting 24-pdrs.[2]

The Americans possessed only three large frigates. Indeed the modest size of the American fleet was another reason for not taking it too seriously. Apart from a number of one-gun boats that capsized immediately the gun was discharged, the United States Navy in late 1811 consisted of six brigs, two 18-gun sloops, and ten frigates. There were no ships of the line.

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1. H.I. Chapelle, "The Ships of the American Navy in the War of 1812", M.M.xviii. 288-89. Clowes, vi. 17-18, 28, 37.
2. Napier, The Navy, pp. 64-66.

The frigate was thus nominally the largest class of American warship, and the newest one had been completed in 1800. On the day Madison declared war, only two frigates of the ten were at sea; two lay in ordinary, three were repairing, one rebuilding, and two were condemned hulks. It was not an impressive navy.[1]

Having destroyed the fleets of Spain, Holland and Denmark, and having driven the remnants of the French Navy from the seas, the Royal Navy was not unduly alarmed by the challenge of the modest American Navy in June 1812. "Contemptuous confidence" had, through uninterrupted success, yielded to what Canning later called in Parliament, "the sacred spell of the invincibility of the British Navy."[2]

In the autumn of 1812 this "spell" was broken. The British frigates Macedonian and Java fell in quick succession to the Americans, proving that Guerrière's defeat in August had not been mere chance. In addition to losing three frigates, the two sloops Frolic and Peacock surrendered to their American counterparts Wasp and Hornet. The Royal Navy had not lost so many vessels in

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1. Chapelle, M.M.xviii. 287-88. Clowes, vi. 95.
2. Clowes, vi. 60.

single-ship-combat during twenty years of war with European navies. Moreover, they had lost these five ships in spectacular fashion. The _Constitution_ had so riddled _Guerrière_ and _Java_ that they had to be sunk; neither _Constitution_ or the _United States_, captor of _Macedonian_, suffered damage of any consequence. In the three frigate actions, British casualties numbered over three hundred killed and wounded, compared with about sixty on the American side.[1]

The impact of these British losses was electric. Indignant letters in the British press were matched by Parliamentary speeches clamouring for the resignation of naval administrators.[2] "Nothing chases, nothing intercepts, nothing engages them [the Americans] but to yield them triumph", mourned the "Pilot" a leading maritime authority. Canning speaking in Parliament,

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1. _Ibid._ pp. 34-37, 41-43, 48-53. Douglas, 3rd ed., pp. 147-50, 523-52. Sir Nathaniel Barnaby, _Naval Development in the Nineteenth Century_ (London, 1902), pp. 436-47.

2. L.J. Jennings, ed. _The Correspondence and Diaries of John Wilson Croker_ (London, 1884), i. 44.

observed "it cannot be too deeply felt that the sacred spell of the invincibility of the British Navy was broken by these unfortunate captures."[1] Not only were the Americans encouraged by their victories to successfully prolong resistance to the British blockade, "A Post Captain" (Sir Charles Napier) informed Melville, but British defeat had "opened the eyes of other nations, and shewn them that we are not invincible at sea."[2] Observers other than Napier, notably the Surveyor of the Navy, Sir Robert Seppings, were quick to attribute a revival of French agressiveness in single-ship-combat to the American successes.[3]

To avoid further embarrassments, the Admiralty were determined that no further risks be run against the American super frigates. In the first instance, British 38's on the North

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1. Both these quotations are taken from Clowes, vi. 60. Melville, the First Lord, also expressed concern at the blow to British confidence. N.R.S. Barham, iii. 387; C.J. Bartlett, Great Britain and Sea Power 1815-1853 (Oxford, 1963), p.32.

2. Napier, The Navy, pp. 1, 6, 9, 14, 29-30.

3. Sir Robert Seppings, A Letter Addressed to the Right Honourable Viscount Melville on the Circular Sterns of Ships of War, (London, 1822), p.14.

American Station were ordered to cruise in pairs. When the Americans ventured further afield, Croker persuaded both Cabinet and Admiralty to issue the following secret order to all Commanders-in-Chief:

> My Lords Commissioners of the Admiralty having received intelligence that several of the American ships of war are now at sea, I have their Lordships' commands to acquaint you therewith, and that they do not conceive that any of His Majesty's frigates should attempt to engage, single-handed, the larger class of American ships, which though they may be called frigates, are of a size, complement, and weight of metal much beyond that class, and more resembling line-of-battle ships.[1]

This strategy of avoiding combat, together with a practical refutation of Jefferson's contention that America's seaboard defied blockading, effectively neutralized the American threat. Although British commerce continued to lose heavily to privateers, United States trade practically ceased altogether. More important from the standpoint of morale, no further spectacular refutations of British invincibility occurred.[2]

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1. Adm.2/1377, Admiralty to Commanders-in-Chief, secret, 10/12 July 1813. Jennings, ed., Croker, i. 44-45. Bartlett, p. 31.
2. Clowes, vi. 59-65, 69. Napier, Navy, p.9.

In what way, then, were the American frigates so superior to those of Britain that the latter were ordered to avoid them? The answer is quite simple: they were superior in practically every way. In the first place, they were larger. The extent of this advantage in size has, unfortunately been obscured for two reasons: firstly, defeated British captains tended to magnify American superiority while the Americans preferred to minimize it; secondly the American methods of ship mensuration, "carpenters' tonnage" and "registered tonnage", were not comparable with each other, with the two equivalent forms of British mensuration, or with present day measurement by displacement.[1] The most convenient criterion of comparison is, therefore, that used by H.I. Chapelle in his definitive study of the American frigates in the War of 1812.

Chapelle resorted to measuring the length of the ships between ~~particulars~~ perpindiculars drawn from the extremities of their main decks. In this respect all the American 44's measured 174 feet

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1. Chapelle, M.M.xviii. 233-34. Clowes, vi. 27-28. See also Andrew Murray, Ship-Building and Steamships - the Theory and Practice of Shipbuilding (London, 1861), pp.157-60.

10½ inches; the Macedonian on the other hand, was only 157 feet 3 inches, the Java slightly shorter, and the Shannon 150 feet 2 inches. The British 24-pdr. gun frigate Cambrian, built in 1797, measured only 154 feet. In comparison, the British 74, Mars, was exactly 13½ inches longer than the American super frigates. The latter thus consistently enjoyed a superiority in length over all British frigates, a superiority that was accompanied by increased breadth and depth of hold. In both cases these measurements were only about five feet less than those of the Mars.[1]

But American frigate construction embodied a more significant advantage than that of size. They were much more stoutly built. Professor Albion, in his study of the Royal Navy and its timber problems, revealed the extent to which British ship construction depended upon light fir during the Napoleonic struggles. Even when valuable oak was made available for frigate construction, the scantling was light and the walls thin. The Americans on the other hand had 22-inch walls of live Virginia Oak, and the

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1. Chapelle, M.M. xviii, 290, 296, 301, and The History of the American Sailing Navy (New York, 1949), pp. 312-19.

timbering throughout was heavier than many British ships of the line.[1]

A British visitor found the United States "a tremendous frigate ... a bed of timber", and pronounced her more stoutly built than his own 82-gun ship.[2] British officers inspecting the captured President were equally impressed. The United States was, in Chapelle's estimation, as heavy as the best British 74; the President and Constitution he considered "slightly lighter than the better class of 74-gun ships in the Royal Navy."[3] They were therefore heavier than the other half-dozen types of 74 comprising this rate.

The Admiralty were thus quite justified in comparing the American super frigates to ships of the line in size and construction. These qualities in turn provided the basis for the superiority in armament and complement of crew also referred to in the secret order of November 1814. For a warship is no more than a floating gun platform; and the heavier that platform is built, while providing for proper sailing ability, the heavier

1. Albion, pp. 389-94.
2. Bartlett, Sea Power, pp. 31-32. N.R.S. Dillon, ii. 325.
3. Chapelle, M.M. xviii. 290.

the armaments it can mount. Thus the longer American frigate could carry four guns more than its British opponent. Owing to greater displacement and stout construction it could also support a heavier armament without strain or loss of stability. More important, as the contests of 1812 were to prove, this stability contributed immeasurably to the accurate fire of the American gunners working quickly and efficiently behind the immense protection afforded them by their ships' strong walls.

All these advantages were revealed on August 19, 1812, when Constitution fought and completely destroyed Guerrière. The American carried 54 guns and 456 men, the British 50 guns and a crew of 282. Constitution's thirty-two long 24-pdr. guns and twenty-two 32-pdr. carronades opposed thirty long 18-pdr. guns, two long 12-pdr. guns, and eighteen 32-pdr. carronades. A single American broadside thus weighed 736 pounds compared with Guerrière's 570 pounds. The United States, mounting 42-pdr. rather than 32-pdr. carronades, threw 856 pound broadsides against Macedonian, the latter's weight of metal being slightly smaller than Guerriere's.[1]

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1. Clowes, vi. 34-37, 41-43, Douglas, 3rd ed., pp.403-24, 523-50.

American frigate superiority was obvious; not only were they superior to British 38's, they were more formidable than any of the 24-pdr. frigates, such as the _Pomone_ and _Forte_, that Britain had successfully fought more than a decade before. Despite this fact, the superiority of the American frigate might never alone have turned British success in Europe to resounding defeat in America. To recall Mahan's phrase, it was the "efficient tactical bearing" of improvements in materiel that mattered. The French had not used their heavy frigates to good advantage; the Americans had. Moreover they had succeeded where France had failed by using exactly the same strategy.

It will be recalled that during the Seven Years War, France had adopted a defensive strategy. Based on the premise that the power having the fewest ships must always avoid doubtful engagements, this strategy pitted French warships against British commerce and inferior naval forces. After Trafalgar the French reverted to this "desultory system of naval warfare" with considerable success.[1] In 1812 the Americans possessed by far

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1. Douglas, 3rd. ed., pp.615-16. Graham, pp. 233-34.

the fewest ships, and they adopted the same defensive strategy.[1]

Indeed it was this defensive strategy that had brought about the American super frigate in the first place. For in order to offset their numerical inferiority the Americans built vessels larger than their European counterparts. Such vessels not only enhanced the chances of breaking through a blockade, but could be assured of favourable conditions if forced to fight a European ship of nominally the same rate. It was with this strategy in mind that the American Government in 1793 had Joshua Humphreys draw up plans for even heavier frigates than those the French had adopted for the same reasons.[2]

It is evident then, as Chapelle asserts, "that the Americans did not originate the idea of the heavy frigate; they merely improved it."[3] They also proved notably more successful with heavy frigates than had their French masters. This was largely owing to the fact that whereas France's adoption of defensive strategy arose from a defeatist attitude, the Americans adopted

1. Bowles, p. 41. Clowes, vi. 172. Mahan, pp.538-40.
2. Bartlett, Sea Power, p. 32. Chapelle, M.M. xviii. 289.
3. Chapelle, M.M. xviii. 289.

the same strategy out of pure necessity. In France's case, withdrawal from action increased the demoralization and incompetence that had inspired the policy in the first place. The British had found them easy game. In America's case there was no such demoralization or incompetence; when they chose to fight, they fought well. For this reason they succeeded where France had failed.

It was precisely at this point, when the British engaged the Americans, that they found the yard-arm tactics so successful against the French in similar circumstances, to be totally inadequate. In fact the British frigates found it impossible to get within effective range of the Americans. The latter, with their long 24-pdr. guns stood off beyond the range where the British could fire accurately with their 18-pdrs. They then proceeded to dismast the enemy and silence many of his guns with impunity. With the British frigates sufficiently crippled, the Americans came to close-quarters to end the engagement with murderous point-blank broadsides.[1]

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1. Clowes, vi. 41-43, 48-53. Dupin, Voyages, ii. ii. 137. Lloyd and Hadcock, Artillery, p. 55. Commander James Marshall, A Description of Commander Marshall's New Mode of Mounting and Working Ships' Guns (London, 1829), p. 47.

The British appeared to be helpless in the face of the American tactics. So attached were their captains to the tactics that had defeated France that they persisted in pressing fruitlessly for close-quarters rather than maneuvering to attain, if not victory, at least survival. Most of the accusations of incompetence directed at British officers by naval historians were based on this obsession with obsolete tactics, and the seeming inability to develop a more flexible response to the new situation posed by American gunnery.[1]

For it was upon gunnery that the ultimate success of American strategy and tactics rested. The Americans drilled incessantly, first on land, and then at sea, and their guns were equipped with gunsights and vent tubes to provide a higher degree of accuracy at long-range.[2]

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1. Bowles, p. 41. Chapelle, M.M. xxxix. 233-34. Clowes, vi. 41-43, 172. Douglas, 1st ed., pp. 265-66. Napier, The Navy, pp. 24-25.

2. Adm.1/4021, Ordnance to Admiralty, 22 June 1814 and enclosure. Clowes, vi. 53. Napier, The Navy, p.3.

The British, on the other hand, never drilled on land, and rarely at sea; sights and tubes were practically unheard of, and, as already mentioned, there existed in the Royal Navy a firm prejudice against long-range action.

This prejudice was strikingly illustrated by the fact that it was not until 1813, after the Americans had demonstrated the possibilities of long-range fire, that the Admiralty discovered the range tables of 1790 and 1798 had become obsolete through advances in casting and gunpowder.[1] This belated descovery also provided eloquent comment on the inflexible dependence on yard-arm tactics to defeat the French, and by extension, the failure of the latter to use their long-guns effectively at long-range, as did the Americans.

The Americans, therefore, enjoyed many advantages in the frigate engagements of 1812. In size and stability of ship, in number and calibre of guns, and in efficiency and accuracy of

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1. Adm. 1/4021, Ordnance to Admiralty, 26 April and 28 May 1813.

gunnery, they exercised a great superiority over the British.[1] These advantages, combined with their choice of tactics - choosing the enemy and the range - made the British defeats practically inevetable.

But if stout ships and heavy guns counted for much in the frigate actions, they had no bearing on the outcome of early sloop actions. Here American superiority was confined solely to gunnery. In October 1812, U.S.S. Wasp carried on a running fight in rough seas with H.M.S. Frolic. Size and armament of the two sloops were practically equal, the range only sixty yards. Yet the Americans suffered only ten casualties compared with over ninety aboard the riddled Frolic. Four months later, U.S.S. Hornet carrying twenty 32-pdr. carronades sank, with two broadsides, H.M.S. Peacock mounting nineteen 24-pdr. carronades. Admittedly the American sloop had a considerable advantage in metal; more significant was the fact that not once did Peacock

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1. It is impossible to accurately express the mathematical proportions of this superiority, although Clowes, vi. 48-53, estimates it was in the order of 5 to 4, and Bowles, Pamphlets, pp. 27-33, sets it at 3 to 2.

even touch her adversary.[1]

American gunnery skill from both long- and close-range was therefore a decisive factor in the naval engagements of the War of 1812, and came to be recognised as such by the British. Thus at a court-martial aboard H.M.S. Surprise in January of 1814, the defeat of H.M.S. Boxer by U.S.S. Enterprise was attributed to "a superiority in the enemy's force, principally in the number of men, as well as to a greater degree of skill in the direction of her fire, and to the destructive effects of the first broadsides."[2]

Nor were the Americans the only ones to demonstrate the effects of accurate gunnery. Shannon's celebrated defeat of U.S.S. Chesapeak was widely attributed to the gunnery skills instilled by Sir Philip Broke, H.M.S. Phoebe's defeat of the Essex, attained by staying beyond the range of the latter's complete carronade armament, was again attributed to intelligent tactics and good gunnery, and also demonstrated the ~~perils~~ weakness of

1. Clowes, vi. 38-41, 53-55. Douglas, 3rd. ed., pp. 413-15.
2. Clowes, vi. 89-91.

the carronade as primary armament.[1] But while the need for more *Shannons* with superb gunnery was recognised, the task of introducing the necessary training and mechanics in the midst of war was too great, and had to await the coming of peace. This task is discussed in Chapter Two.

At the same time, the shock of the American victories spurred immediate Admiralty effort to match the Americans in other respects. Some attempt was made to augment the crews of frigates on the North American Station, notably in the cases of *Java* and *Shannon*.[2] These efforts were severely restricted by the size of the vessels, and by the limited number of trained seamen that could be spared from the global struggle against France. In any case, such augmentation as did take place was temporary; after the war, manning the Royal Navy's much reduced peace establishment still posed an apparently insuperable problem.[3]

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1. Robertson, pp. 137-39. Lewis, *Navy of Britain*, p. 546.
2. Clowes, vi. 78.
3. Bartlett, *Sea Power*, 47-49, 123, 138-39, 143, 164, 229-30, 283, 304-315. Bowles, *Pamphlets*, 15-19, 99-100, 109-21, 165, 213, 215-16, 220-39, 299. Napier, *The Navy*, 24-26, 32, 41-42. R. Taylor, "Manning the Royal Navy, The Reform of the Recruiting System: 1852-62" M.M. xliv. 302-13, xlv. 46-58.

Another attempt to match the Americans, during the war had more far-reaching effect. This was the decision to build a class of super frigates. The Admiralty, after first resisting the idea, had two 60-gun frigates ready for the last six months of hostilities, and planned five others of 50 guns. The two 60-gun frigates, Leander and Newcastle, played no important part in the war apart from fumbling an opportunity to intercept Constitution. Built in haste, and of inferior timber, they lacked the stability, strength and durability of the American super frigates. Disappointing ships, they were nevertheless to have a considerable influence on French and American frigate construction after 1815.[1]

The most far-ranging of the Admiralty's activities in 1813, however, was their search for a gun to counter the American 24-pdrs. Perhaps for the first time in the history of naval warfare, a series of combats had been decided by naval artillery at long-range. Britain's endeavours to provide her navy with a

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1. Adm.1/4021, Ordnance to Admiralty, 26 Feb. 1813, enclosing Sir Thomas Blomefield to Ordnance, 25 Feb. 1813, minute. Albion, pp. 390-93. Bartlett, Sea Power, pp. 31-32. Bowles, Pamphlets, pp. 41-44. See below Chapter Three.

similar capacity completely reversed the trend of naval warfare that had, for the last two centuries, been leading towards light, handy artillery fired at close-range, and that had culminated in the carronade and the "Nelson touch". In reversing this trend, Britain sounded the modest opening note in an armaments race that reached its crescendo in the late nineteenth century.

The superior range of the American long-guns over the British 18-pdr., demonstrated in the frigate and sloop actions of 1812, also proved a significant factor in American victories on the Great Lakes. Chauncey on Lake Ontario, and Perry on Lake Erie, displayed the same skill in their use of tactics and long-range as had the officers of the Constitution and United States.[1] Thus in September 1813, finding his flotilla outmaneuvered and at the mercy of the wind and American 32-pdrs. Sir James Yeo reported:

> I found it impossible to bring them [the Americans] to close action. We remained in this mortifying situation five hours, having only six guns in the fleet that would reach the enemy.

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1. Clowes, vi. 110-30.

In November, Yeo requested long 24-pdr. guns for his flotilla.[1]

This was not a very realistic request. For it was improbable that many of Yeo's tiny ships could have carried the tremendous weight of 24-pdrs. British guns of this calibre were of two sizes; the nine-foot model weighing 47 cwt., and a nine-foot six-inch model of 50 cwt.[2] Only the most stoutly built ships in the Royal Navy could carry them. They were in 1813 provided only for the middle decks of first-rates, the upper decks of "some" 74-gun ships, the lower decks of 64-gun ships, and "sometimes the larger class of frigate."[3] Thus if Britain were to provide these heavy weapons to all vessels, down to and including the brigs on

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1. Douglas, 3rd. ed., p. 48. Guns in the lakes engagements were heavier than those in the frigate engagements. The Americans mounted mostly 32-pdrs. and the British short 24-pdrs. and long 18-pdrs. C. Winton-Clare, "A Shipbuilder's War", M.M.XXIX, 139-48. See also C.P. Stacey, "Another look at the Battle of Lake Erie", C.H.R. XXXIX, I.

2. W.O.44/498, Royal Arsenal Return of Sea Guns, 29 March, 1813.

3. Adm.1/4021, Ordnance to Admiralty, 21 July 1813.

Lake Ontario, she would have had to either reduce drastically the number of guns per rate, or rebuild the greater part of her navy.

Neither of these alternatives was palatable. The Admiralty sought some form of compromise. In January 1813, 24-pdr. guns six feet six inches in length and weighing 33 cwt. were tested aboard H.M.S. Venerable and H.M.S. Daedalus. Not only did these guns not have the desired range, but the violence of their recoil rendered them both unsafe and inaccurate. In any case they were too short to permit the muzzle to project safely beyond the wall of an average frigate. For these reasons no tests were made on an even shorter model, six feet long and weighing only 31 cwt.[1]

It was obvious that as none of the existing 24-pdrs. met the requirements of long-range and light weight, new models capable of equaling the Americans in range, but light enough to serve in British frigates, would have to be devised. A month following the disappointing tests aboard Venerable and Daedalus, the Inspector of Artillery, Sir Thomas Blomefield, submitted plans

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1. Ibid. 12 Feb. 1813, enclosing Select Committee Report to Ordnance, 25 Jan. 1813.

for a new eight-foot model weighing 42 cwt. The Admiralty rejected Blomefield's proposal on the grounds that, while "it would be of great importance to have a 24-pdr. gun which might be carried by frigates .... their Lordships envision that such guns ought, if possible, not exceed 40 cwt."[1]

Plans for such a gun had already been submitted by Colonel William Congreve. The son of the Royal Laboratory Superintendent of the same name, Congreve had received the grand title of Superintendent of Military Machines for his work in perfecting the war rocket. His inventive mind was also to provide great improvements in gunpowder and its storage, gun and carronade carriages, gunsights, and numerous other contributions to the advancement of artillery.[2]

Recognising the need for a gun with which to oppose the

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1. Ibid. 26 Feb. 1813, enclosing Sir Thomas Blomefield to Ordnance, 25 Feb. 1813 and minute.

2. Congreve (1772-1828) spent most of the war years with experimental rocket battalions and directed rockets at Leipzig in 1813. Attached to the Royal Laboratory in 1791, he succeeded his father as Comptroller and second baronet in 1814. He wrote many articles on his work, and on currency, and was also Member of Parliament from 1812-28. D.N.B.

Americans, Congreve submitted his proposals early in 1813.[1] Unlike Blomefield's projected gun, that of Congreve involved more than producing a new model of the old pattern 24-pdr. In fact his proposals of February 7, 1813 involved a completely new approach to the design and casting of heavy guns. So revolutionary was Congreve's proposed gun, that it attracted immediate and violent criticism from many influential artillerists, a fact that prevented its appearance in time to seriously oppose the Americans. Yet so great a part did this gun play in the rearmament of the Royal Navy after 1815, and such was its influence on the future design of heavy guns, that it deserves close study.

Congreve was convinced "not only that no serious improvement has been made in the construction of cannon for the last <u>two hundred years</u>, but that in fact up to the present period no

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1. Adm.1/4021, Congreve to Rear Admiral Hope, 7 Feb. 1813, and Congreve memo of 31 Jan. 1813, both documents enclosed in Admiralty memo of 10 Feb. 1813. See also William Congreve, <u>A Concise Account of The Origin of the New Class of 24-pdr. Medium Guns, at reduced Length and Weight, Proposed by Colonel Congreve, for the Arming of Frigates</u>,(London, 1814).

fixed principle appears to have been acted upon..."[1] He immediately set about providing both the improvement and the principle. The principle used to determine the length of his gun was the Prussion artillerist Euler's "theory of coincidence of length to weight of charge." As the shot weighed 24 pounds, and the British regulation charge was established at one-third the weight of the shot, Euler's theory indicated that existing British 24-pdrs. were either too long or too short for their charge. The correct length should have been seven feet six inches.[2]

Congreve thus proposed that his 24-pdr. gun be seven feet

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1. W.O.44/498, Congreve to Ordnance, 9 March 1814, in packet "Correspondence, Reports and Experiments relative to the New Construction for Ordnance proposed by Sir. Wm. Congreve, 1813, 1814, and 1815."

2. It would be difficult for a layman to explain Euler's theory and in any case, Congreve himself did not see any necessity for doing so. Yet it is of interest to note that Congreve's gun was the first to have its length based on scientific principles, the lengths previously being determined by the capacity of the various ships' decks. (See W.O.55/1823, manuscript entitled "A Treatise on Artillery", 1780 (?), by C.D. (Charles Douglas?), fos. 10-11.)

six inches long, and weigh "not less than 40 cwt." The most distinctive feature of the weapon however, was in its shape and distribution of metal. By "making it in the carronade figure" Congreve removed the traditional tulip and much of the metal that distinguished the muzzles of common pattern guns. This weight he redistributed at the breech to give added strength, velocity, and, it was hoped, range.[1]

This great preponderence of weight at the breech of the gun necessitated moving the trunnions toward that part in order to maintain proper balance on the carriage. Placing the trunnions near the breech in turn solved one difficulty inherent in short guns, ~~and~~ a difficulty which was demonstrated when testing the six-foot six-inch model; that was the problem of having the muzzle project a safe distance beyond the ship's side. With the trunnions further inboard, Congreve's gun would project about the same distance as existing long-guns. Thus if it did possess the ranging power of a long 24-pdr., while weighing two hundred pounds less than the long 18-pdrs. common to frigates, Congreve's gun would provide

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1. Adm.1/4021, Admiralty memo. of 10 Feb. 1813, enclosing Congreve to Hope, 7 Feb. 1813.

equality with American weaponry. Moreover, it would provide this equality without necessitating expensive alterations to the ships of the Royal Navy.[1]

There was little need to remind the Admiralty in 1813 that the weapon's suitability as an armament for frigates was "not the least important point of consideration."[2] Immediate orders for experimental models were placed with the Carron Company of Scotland. Early in June the first Congreve guns, thirty in number, were allocated to the frigate Cydnus.[3]

Not until September 1813 did the new guns see action. In a sharp frigate engagement, H.M.S. Eurotas, carrying Congreve 24-pdrs. and standard long 18-pdrs., captured the French frigate La Colinde mounting 18-pdrs. Captain Phillimore's report on the new gun was highly favourable. Apart from a somewhat harsher recoil than the 18-pdr., Congreve's gun had a better range, enjoyed a greater horizontal sweep owing to its tapered muzzle,

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1. Ibid.
2. Ibid.
3. Adm.1/4021, Ordnance to Admiralty, 12 Feb. 1813; 12 April 1813 enclosing Congreve to Ordnance, 9 April; 9 June 1813 and minute.

and, with two fewer crew, fired three rounds in the same time as the 18-pdr fired two. Encouraged by this report, the Admiralty requested the Ordnance Department to fit out several additional frigates with Congreve guns.[1]

Ordnance refused to do so. In fact they refused to have any more Congreve guns cast until exhaustive testing could be carried out at Sutton Heath. Instead the Admiralty were advised to arm six new frigates with guns of the same size and weight designed by Sir Thomas Blomefield, Inspector of Artillery.[2] The Admiralty were outraged. In a memorandum later delivered to Ordnance, they deplored that department's casting new guns "without any authority". They were further incensed by the proposal to arm six frigates "without any experiment and yet with Captain Phillimore's favourable report, and this Board's directions, they will not cast a gun of Colonel Congreve's."[3]

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1. Adm.1/4021, Ordnance to Admiralty, 8 Oct. 1813; enclosure and minute. W.O.44/498, Select Committee Report to Ordnance, 25 April 1814 and enclosures. Add. MSS.41367, fos. 86-93; 41406, fos. 71-72.

2. Adm.1/4021, Ordnance to Admiralty, 13 Oct. 1813.

3. Ibid. Admiralty Memo. later sent to Ordnance, 14 Oct. 1813.

The reply to this rebuke was equally testy. After pointing out that the Blomefield guns had not been provided for naval service only, Ordnance concluded:

> ... without commenting upon the terms in which the communication of their Lordships' sentiments is couched... or upon the inadmissable and unprecedented tone of authority assumed in it, the Board desire to remark, with regard to the provision of these guns, that it is not necessary for them to justify that measure to the Lords of the Admiralty, and that they receive orders from the Master General of the Ordnance only.[1]

The Admiralty rejoined that regarding naval matters, "their Lordships cannot but think that their opinion is of the highest authority whenever they shall see occasion to express it."[2]

The relationship between these two departments, and the authority of each regarding the provision of naval armaments, is discussed in Chapter Five. It is sufficient to say at this point that the diametrically opposed opinions of the two boards expressed above, were both substantially correct. This did not expedite matters, however, for this inter-departmental conflict seriously delayed the fulfillment of the Admiralty's desire for a 24-pdr.

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1. *Ibid.* Ordnance to Admiralty, 18 Oct. 1813.
2. *Ibid.* minute.

to combat the Americans.

The conflict began within the Ordnance Department. It will be recalled that shortly after Congreve submitted his plans to the Admiralty, an eight-foot 24-pdr. weighing 42 cwt. had been submitted by the Inspector of Artillery, Sir Thomas Blomefield. The Admiralty had rejected Blomefield's plan, stipulating that guns proposed for frigate armament should not weigh more than 40 cwt. They then proceeded to order Congreve guns despite Ordnance reluctance and in the face of criticism from several naval officers.[1]

Blomefield promptly designed and had cast several guns exactly equal in length and weight to those of Congreve, but in the traditional mould. He had this done through his own authority within the Ordnance Department, and without consulting the Admiralty. The latter thus felt "some degree of surprise" when informed in September 1813 that a number of Blomefield guns were ready for service.[2] Surprise gave way to the extreme

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1. Ibid. Ordnance to Admiralty, 12 Feb. 1813, enclosing Sir Home Popham and Rear Admiral David Milne to Ordnance, both dated 26 Jan, 1813.

2. Ibid. Ordnance to Admiralty, 27 Sept. 1813, minute.

displeasure, already described, when subsequently informed that only Blomefield guns were available, and that no more Congreve guns were to be cast until existing ones were thoroughly tested by Ordnance.

Blomefield's furtige activity had probably begun out of pique at Congreve's intrusion into his domain; it culminated in a thunderous defence of the existing pattern of heavy gun against Congreve's new style. In this defence he did not stand alone. Most of the committees involved in testing Congreve's gun revealed a marked prejudice against it. In their opinion, its distinctive shape blended the "four acknowledged imperfections" of shortness, trunnions near the breech, thin metal at the muzzle, and heavy metal at the breech. That a heavy breech could impart increased range was "repugnant to theory", while the conception of the gun was "against nature."[1]

In November, 1813, tests were carried out at Sutton Heath before a mixed committee of naval and artillery officers. Not

1. W.O.44/498, Select Committee Reports, 25 March, 7 April and 12 Dec. 1814. Adm.1/4021, Ordnance to Admiralty, 26 June 1815 and enclosures.

only did Congreve's gun outrange those of Blomefield, it also outranged the largest 24- and 32-pdr. guns in service. It did, however, have a harsh recoil, and its superiority over the larger guns was not consistent. The committee pointed out the extreme regularity of the heavier guns, and intimated that such success as the gun did enjoy could be imputed to accidental causes. If short guns were absolutely necessary for the navy, the committee advised that Blomefield's gun with its "established configuration" be adopted.[1]

The Admiralty and Colonel Congreve appeared to be the only enthusiastic supporters of the new weapon.[2] Colonel Henry Shrapnell, inventor of the shell bearing his name, concluded, probably correctly, that the trials at Sutton Heath were too inconclusive to warrant attaching much importance to them.[3]

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1. Adm.1/4021, Ordnance to Admiralty, 29 Nov. 1813 and enclosures; 4022, Ordnance to Admiralty, 26 June 1815 and enclosures.

2. W.O.44/498, Congreve to Ordnance, 9 March and 12 Aug. 1814, 1 June, 1815.

3. Ibid. Colonel Henry Shrapnell to Lord Keith, 25 March 1814. See also Douglas, 3rd ed., p.216, and Dupin, Voyages, ii.ii. 99-100.

The Admiralty, however, believed these trials had proved Congreve's gun the best available with which to fight the Americans, and stoutly insisted that they be mounted on the Montreal, Niagara and Star preparing on Lake Ontario.[1] The order was placed in January 1814. Shortages and Ordnance procrastination delayed the first shipment until late summer, when sixty-six were embarked on the transport Stranger, and promptly captured by an American privateer.[2]

There is no evidence to indicate that the Congreve gun played any important role against the Americans. As was the case with the super frigates Leander and Newcastle, they were to exercise much more influence in the peace following the war that brought them into being. Nevertheless, by introducing these guns and frigates, the Admiralty indicated they were capable of learning from the Americans. The most significant lesson from the War of 1812, and the one most reluctantly accepted, was the fact that the yard-arm tactics employed in Europe could no longer

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1. Adm.1/4021, Ordnance to Admiralty, 28 and 31 Jan., 4 Feb. 1814 and minutes, 9 July 1814 and enclosures.
2. Ibid. 19 Oct. 1814.

be relied upon to provide victories. Long-range skill was also necessary. To attain this skill demanded that attention be paid to the gunsights, vent tubes and gunnery training, that had so much contributed to the American victories. This was done after 1815.

Chapter Two

SIR HOWARD DOUGLAS AND THE GUNNERY LESSONS OF 1812

The War of 1812 brought about a remarkable transformation in the Admiralty's attitude toward naval gunnery. Before 1812 it had shared with other European navies the belief that long-range accuracy at sea was impossible, and that any effort to attain such accuracy would be wasted. Training had consequently been restricted to teaching the mechanics of loading and firing quickly and efficiently for close-quarters combat. The Americans on the other hand had proved that the use of heavy artillery, combined with sighting aids and intense gunnery training, resulted in a considerable degree of accuracy at long-range, and maximum utilization of fire-power at close-range. This lesson was not lost upon the Admiralty. Between 1815 and 1820 steps were taken to improve guns and to train gunners. Gunsights and vent tubes were introduced to increase the accuracy of the weapon, and gunnery manuals and gunnery training to increase the skills of the men. Heavier guns were mounted. The Admiralty's new enthusiasm, while bringing about many significant gunnery reforms, was not sufficient to overcome the hurdles of retrenchment and conservatism. In particular the navy was not prepared to accept the many suggestions of Sir Howard Douglas for improving naval gunnery, and Douglas's suggested gunnery training ship, windage reduction and new flint locks were not adopted until much later. In 1820, however, these and numerous other suggestions of Douglas were published in his immensely influential treatise on naval gunnery.

Overall American success in ship combat was largely attributable to the superior accuracy of American gunnery, an accuracy attained through constant drilling and through the use of such small but important improvements as gunsights and vent tubes. The benefits to be derived from the use of gunsights, especially where long-range was concerned, are obvious; the value of vent tubes perhaps requires some explanation. To discharge heavy artillery required some means of conducting fire from outside the gun into the gunchamber housing the charge.

In earliest days this had been accomplished by the simple but dangerous expedient of inserting a red hot spike into the vent, a practice that, by the middle of the fifteenth century, had given way to igniting loose powder trailed across the top of the gun and into the vent. This method, practically as dangerous as that it replaced, was also useless in wet or windy weather. By the late seventeenth century, therefore, quickmatch was inserted into the vent and touched off, at first by portfires, but after 1790 by flintlocks.[1]

But quickmatch required priming, thereby necessitating on deck loose powder with its attending dangers. Moreover, quickmatch burned slowly; on a pitching deck this meant that the interval between touch and discharge could find the muzzle in a totally different relationship to the target than at the time of aiming. By enclosing rapid-burning priming powder in vent tubes, the dangers of loose powder on deck could be done away with, and the moment of aim and ignition made more nearly simultaneous. Thus gunsights improved the accuracy of aim while vent tubes helped to

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1. V.D. Majendie, Ammunition for Smooth-bore Ordnance (London, 1867), pp. 187-92. Douglas, 3rd ed., pp. 384-90.

ensure that the gun discharged at the proper moment.

Both these devices had been rejected by the Admiralty when suggested to them prior to 1812. Thus tubes submitted independently by Captain J.A. More, R.M.A., and a Captain Robinson, R.N., were in 1810 declared unnecessary for naval guns,[1] and captains requesting gunsights were advised that such novelties were "not according to the regulation of the service."[2] Nelson himself reflected the British attitude to sights when their introduction was suggested to him in 1801:

> As to the plan for pointing a gun truer than we do at present, if the person comes, I shall, of course, look at it, or be happy, if necessary, to use it; but I hope we shall be able, as usual, to get so close to our enemies that our shot cannot miss the object.[3]

Certainly British reluctance to adopt sights and tubes had considerable justification. The inaccuracy of heavy guns throughout the eighteenth century, owing not only to ship motion, but also to defects in gunpowder as well as to imperfections in

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1. Ind.4938: 59-4, 15 Nov. 1817.
2. Robertson, Naval Armament, p. 154
3. Nelson to Sir E. Berry, 9 March 1801, cited in Lloyd and Hadcock, Artillery, p. 33, note.

the casting and reaming of shot and bore, rendered effective long range accuracy practically impossible. William Monson's sixteenth century dictum "for he that shooteth far off at a ship had as good not shot at all",[1] was still largely applicable in 1801. Moreover, as Nelson had observed in connection with gunsights, European naval tactics rendered long range accuracy unnecessary in any case. Thus improvements in gunpowder and gun casting immediately before and during the Napoleonic Wars, improved gun accuracy, but did not convince the Admiralty that a comparable increase in sighting accuracy was called for.[2] But American use of sights and tubes, in addition to thorough gunnery training, had resulted in highly effective gunnery both at long- and close-range, and convinced the British of the need for something more sophisticated than their existing rough line of metal sighting and trunnion elevating scales.[3]

In August of 1813, Sir Thomas Blomefield of the Ordnance

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1. N.R.S. Monson, iv. 43.
2. Robertson, p. 154. For improvements in gun casting, etc., see above Chapter One.
3. Douglas, 1st ed., pp. 223-27.

Department believed an "ingenious contrivance" suggested by Captain Truscott, R.N., while not sufficiently accurate for pointing land artillery, was adequate "to draw the attention of sailors to so essential a part of their duty."[1] The Admiralty ordered that one hundred of these tangent sights be tested aboard *Medway*, *Rivoli* and *Benbow* at Portsmouth. Blomefield also had a graduated sight of his own construction tested aboard *Medway*. Neither sight was satisfactory.[2]

The Admiralty, undeterred by these disappointments, continued to encourage "any attempt which leads the attention toward good

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1. Adm.1/4021, Ordnance to Admiralty, 2 Aug. 1813, enclosing Sir Thomas Blomefield to Ordnance, 31 July 1813 and minute.

2. Adm.1/4021, Ordnance to Admiralty, 13 Aug. and 8 Oct. 1813 and minutes, 12 Jan. and 22 June 1814 and enclosures, 30 Dec. 1814. For further information on sights around this time, see W.O.44/498, packets entitled "Tangent Sights for Naval Guns - Captain Truscott - 1814", and "Sights for Naval Guns - John Hookham". See also Douglas, 1st ed., pp. 223-27, 3rd. ed., pp.374-79; H. Garbett, *Naval Gunnery* (London, 1897), pp. 22-23; J.H. Stevens, *Some Description of the Methods used in Pointing Guns at Sea* (London, 1834), pp. 8-12, appendix.

direction in pointing Sea Service Ordnance."[1] Nor were they discouraged by those officers who defined such refinements as gimcracks. Blomefield, though he sought adequate sights, felt them to have limited naval value, especially between decks[2] while a critic of Congreve's new gun remarked that its cast foresight would be useless in sea practice.[3] The Admiralty, on the other hand, wondered if all guns and carronades for naval service should not be cast with such a sight. Ordnance did not feel this would be practical.[4] Despite disappointments and criticisms, the Admiralty continued the effort to improve British gunnery, and by 1816 a number of experimental gunsights and vent tubes were undergoing trials.

In the autumn of that year, Lord Exmouth's bombardment of

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1. W.O.44/498, John Hookham to Ordnance, 31 Jan. 1815 and minute. See Ibid. 3 Feb. 1815, and Ind.4933: 59-4, 19 Oct. 1816.

2. Adm.1/4021, Ordnance to Admiralty, 22 June 1814, enclosing Sir Thomas Blomefield to Ordnance, 21 June 1814. Concerning opposition to innovations that were "not coarsely simple", see Douglas, 1st ed., pp. 10-11.

3. Add. MSS. 41367, Martin Papers, fos. 86-93, undated and unsigned reports on Congreve's gun.

4. Adm.1/4021, Ordnance to Admiralty, 26 June 1815.

Algiers presented the opportunity to test these and other innovations in action. Apart from gunsights, vent tubes and other innovations such as chain cables, Congreve's improved carronade carriages and powder magazines, war rocket and 24-pdr. medium ship gun, took part in the engagement. Congreve guns had been allocated to the upper deck of the flagship, Queen Charlotte, while sights designed by Captain Farquahar, R.N., and tubes by Lieutenant Fynmore, R.M.A., were issued to three frigates and three ships of the line.[1]

So far as the sights, tubes and Congreve guns were concerned, only the first-mentioned failed to receive favourable reports from Algiers. This was owing to the fact that while gunsights had appeared promising in pre-battle exercise, the action itself was fought at close range and largely obscured by smoke, so that no proper assessment of their value could be made.[2] Fynmore tubes and Congreve guns, on the other hand, received generous praise.

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1. W.O.44/498, Admiralty to Ordnance, 14 May 1816. Ind. 4933: 59-4, 10 May, 10 July, 19 Sept., 11 Oct. 1816. N.R.S. Martin, iii. 69-70. C.N. Parkinson, Edward Pellew, Viscount Exmouth (London, 1934), pp. 439-62.

2. N.R.S. Martin, iii. 69-70.

Not only had the tubes worked well, but their quill construction made them safer to use than those of tin used by the Americans and by H.M.S. Shannon.[1] Exmouth recommended these tubes, and with his flag captain, Brisbane, expressed "unqualified approbation" for the Congreve guns, although gunnery lieutenant Cairns complained that their recoil was dangerous, and so harsh as to frequently smash their muzzles against the deck.[2]

The reports from Algiers encouraged the Admiralty to continue working towards the American standard of gunnery. In the first place they were satisfied that Congreve's light 24-pdr. would match the range and weight of metal of American artillery, and relied upon this gun to an increasing degree for upper deck armament. First ordered to the upper decks of all first-rates in April, 1815, Exmouth's favourable report caused the Admiralty to replace with Congreve guns the 12- and 18-pdrs. forming the upper

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1. Ind.4933: 59-4, 12, 20 Oct. 1816. Douglas 1st ed., 232-35; Dupin Voyages, ii.ii. 124-26.

2. Ind.4953: 59-4, 12 Oct. 1816. Exmouth had specifically requested these guns for the upper deck of his flagship, Ind. 4926: 6, 16 April 1815.

deck armaments of second- and third-rate ships of the line. By 1819, no such ship unable to mount at least Congreve 24-pdrs. was to be rated higher than a 74-gun ship. As the 74 was no longer considered sufficiently powerful to serve in the line, this meant that the 24-pdr. was to be the minimum battery calibre in ships of the line.[1]

Thus, despite continued controversy over its design and harsh recoil, and notwithstanding fears expressed by Byam Martin,[2] Controller of the Navy, that the weight of these guns, together with the increased ballast required to support them so high above the waterline, would impair the navy's sailing qualities, Congreve's gun became possibly the most common upper deck armament in the Royal Navy. Not until new armaments were issued in 1829 was it

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1. Ind. 4926: 6, 10, 12 and 16 April 1815; 4938: 6, 20 and 26 June 1817; 4947: 6, 8 Nov. 1819.

2. Martin (1773-1854) first served in the navy in 1786 and commanded various ships off Irish and French coasts and in the West Indies - Rear Admiral in 1811, Comptroller of the Navy 1815-31, M.P. For Plymouth 1818-31. His private papers are most useful for this period. D.N.B.

largely discontinued, although it continued to form practically the entire heavy gun armament of East Indiamen until well into the 1830's, and served with the Royal Navy as a bored-up 32-pdr. as late as 1852. Moreover its heavy breech and tapered muzzle were to furnish the pattern for the shell guns of the eighteen twenties, and for practically all heavy artillery after the eighteen thirties.[1]

Experiments following Algiers also brought about the introduction of gunsights and vent tubes. Throughout 1817 trials were successfully carried out on Fynmore and Congreve tubes at Portsmouth, Plymouth, Sheerness and Cork, and in the summer of 1818 both patterns were approved for service.[2] The following year a

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1. Ind.4926: 6, 10 and 12 April 1817, Douglas 3rd ed., p. 212. Marshall, Ships' Guns, pp. 71-73. Paixhans, Nouvelle Force Maritime, pp. 66, note, 171-82. Dupin, Voyages, ii. ii. 148-49. T.F. Simmons, A Discussion on the Present Armament of the Navy, etc. (London, 1839), p. 70.

2. W.O.44/498, Sir William Congreve to Ordnance, 27 June and 3 July 1817, 20 July and 28 Aug. 1818. Adm.1/4023, Ordnance to Admiralty 10 Dec. 1817. During the first six months of 1818, 37,000 tubes of both descriptions were issued to eleven ships and three depots. W.O. 44/498, Return of the Royal Laboratory, 24 July, 1818.

committee of naval and artillery officers at Woolwich concluded that sights, too, were necessary for the naval service. From the variety of gunsights tested at that time, the committee selected two patterns for service and further comparison, one of them by the indomitable Congreve, the other by Captain Henry Duncan, R.N.[1]

But although vent tubes and gunsights had been adopted by 1819, all ships in the Royal Navy did not receive the former until 1824, and as late as 1828, many guns in the fleet were still without sights. There were three reasons for these delays. Firstly, as mentioned above in connection with gunsights, there existed considerable prejudice on the part of some authorities against innovation in general, and against refinements in the rough-and-tumble of sea combat in particular. Secondly, the realization that any innovation was open to further improvement

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1. Adm.1/4024, Ordnance to Admiralty, 10 Nov. 1819, enclosing Select Committee Report of 4 Nov. 1819. See also ibid. Ordnance to Admiralty, 12 Nov. 1819, enclosing Lieutenant General William Cuppage to Ordnance, 5 Nov. 1819, and enclosures.

discouraged the too hasty introduction of one pattern of gunsight; ~~for example, as~~ to do so would render the introduction of improved patterns confusing and prohibitively expensive.

The third reason for the delay in introducing sights and tubes was simply the matter of expense in a period of severe economic depression and reduced military spending. Thus tubes did not become general in the Royal Navy until 1824 for the simple reason that it required six years to wear out the powder horns they were replacing. Similarly, the sights approved in 1819 were not issued in quantity because Ordnance, with the responsibility for paying for them, bluntly informed the Admiralty that perhaps better but certainly cheaper sights could be devised.[1]

To be sure, the financial savings realized from the gradual

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1. Adm.1/4024, William Cuppage at the Royal Carriage Department to Wellington, 5 Nov. 1819. W.O.44/498, Admiralty to Ordnance, 28 Aug. 1818. The cost of outfitting one 74-gun ship with Hookham sights was estimated at £312. W.O.44/498, packet entitled "Inventions - Sights for Naval Guns - John Hookham, Jan. - Dec. 1819", John Hookham to Ordnance, 11 Nov. 1819.

introduction of sights and tubes was an insignificant part of the economics effected in British military spending between the years 1815 and 1820, and indeed beyond those years. But there could hardly be a better illustration of the effect of economic depression and parsimony on reforming efforts within ~~pressure on the endeavour to reform~~ the Royal Navy. If the need for economy could delay something as cheap and uncomplicated as a vent tube for six years, what was to be the effect of retrenchment on the casting of new and more powerful ordnance, on the building of super frigates, and on the setting up of gunnery schools and depots? Although it is beyond the scope of this work to study thoroughly the economic situation after 1815, some attention to the effect of retrenchment on naval armaments is necessary.

Britain faced in 1815 a situation remarkably similar to that of 1763. On both occasions the problem had been to ensure the continuance of wartime naval supremacy during a peace marked by severe economic depression when funds were not readily voted by Parliament. After 1763, as discussed elsewhere,[1] naval spending

1. See below Chapter Three.

had been so drastically reduced as to contribute to Britain's loss of the seas during the American Revolution. Having learned from this experience that defeated navies replaced their losses with improved vessels and armaments, and doubtless aware that the example of American victories in 1812 would not be lost on other naval powers, Britain's naval retrenchment after 1815 was to be less severe than had been the case following 1763.

To be sure, Lord North's words after 1763 that the cost of "great Peace Establishments will, if we do not take care, prove our ruin",[1] were echoed in the years following 1815. Wellington's fear that distressed national finances rather than disarmament would weaken Britain was shared by Melville, the First Lord, who believed that Britain's true strength lay in her ability to finance war, and that therefore the first object during peace "ought to be the husbanding of our pecuniary means." To this end he declared himself "quite ready to cut down without compunction

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1. Bartleet, Sea Power, p. 1.

every expense that can safely be spared."[1] Byam Martin, the Controller, was also resigned to "the measures which in justice to the public interest we have been obliged to adopt."[2]

Firmly as Martin and Melville believed in the need for economy, they nevertheless protested vehemently and usually without success, when the Government insisted on yet further cuts in what the Admiralty considered to be dangerously low naval estimates.[3] Yet despite the fact that government spending fell from nearly seventy millions in 1817, to less than fifty millions in 1823, and notwithstanding fierce Parliamentary debate of the Naval

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1. Ibid. p. 16. Bartlett's section on "Economy and the Post-War Navy", pp. 13-21, is particularly useful for an understanding of this period. In this connection see also G.S. Graham, The Politics of Naval Supremacy: Studies in British Maritime Ascendancy (The Wiles Lectures given at Queen's University, Belfast, 1964. Cambridge, 1965)), pp. 105-11.

2. Add. MSS. 41394, Martin to Sir George Grey, 24 Feb. 1817.

3. Add. MSS. 41395, Martin memo. 16 Jan. and 5 July, 1821, Melville to Martin, 6 Feb. 1822, and Martin to Melville, 29 July 1822.

Estimates, annual naval spending between those same years was consistently in the vicinity of six millions, and the dockyard vote in 1821 remained almost as high as it had been in 1813 when six or seven times as many large ships were in commission.[1] The reason for this last figure was the need to replace many decaying ships of wartime construction, a need recognized not only by the Admiralty, but also by the 1817 Select Parliamentary Committee on Finance in the opening paragraph of its sixth report.

> Esteeming the Naval Superiority of this Country as the principle on which its external power, internal safety, and general prosperity, in the highest degree depend, Your Committee are of opinion, that the sense which they entertain of the necessity of economy, cannot, with a due regard to the interest of the State, be allowed to interfere with the support of such a Maritime force as may be deemed necessary in time of peace, nor with the adequate preparations for its augmentation in the event of war. And as Naval Expenditure in time of peace is principally connected with the purchase and preparation of materials for future exigency, there is no part of the Public Service in which an ill-judged temporary economy might be ultimately productive of such a considerable expense.[2]

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1. Bartlett, pp. 17-21.
2. P.P. (1817), iv. 181; (1818), iii. 169. Bartlett, p. 21.

Thus despite unrelenting pressure to exercise every possible economy, the Admiralty were not alone in striving to avoid the mistakes made after 1763, and the navy was by no means starved of funds.

It was to be a different matter with the Ordnance Department, the department responsible for providing and financing naval weapons.[1] For if the navy had difficulty in passing its estimates in 1816, the Army Estimates, containing those of Ordnance, were nearly thrown out. "The history of Parliament", wrote Castlereagh, "does not furnish an instance of so protracted and determined an opposition to the Army Estimates."[2] Nor did the Parliamentary Finance Committee's sympathetic understanding for the navy's problems extend to those of the Ordnance Department.

Upon investigating the armouries of that department, the Committee were amazed, as were the Czar of Russia and a distinguished French economist, Charles Dupin, to discover a wealth of materiel completely unexpected in a nation purportedly

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1. On the Admiralty-Ordnance relationship see below Chapter Five.

2. Bartlett, p. 14.

exhausted by twenty-five years of war.[1] Further inquiry revealed the Ordnance Department's custom of greatly inflating estimates in order to lay by desirable reserves of equipment. Although Ordnance could claim in 1817, as had the navy, that much of its equipment was not of the latest pattern or best quality, and therefore required replacing, the Committee directed that existing equipment be used, and warned that the continuation of inflated estimates would warrant "marking something more than mere disapprobation".[2]

The Ordnance Department mended its ways. The production of all naval ammunitions and stores, discontinued in 1815, was limited after that date largely to the preparation of experimental materiel in small amounts. In 1816 a visitor to Woolwich found only the Carriage Department working, and the cost of naval armaments, believed in 1818 to be incapable of reduction below ten shillings per man per lunar month, was in

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1. Dupin, Military Force, ii. 170-71.
2. Ibid. i. 238-40.

fact halved by 1822.[1]

Reduced Ordnance spending after 1815 thus played a considerable part in delaying the production of sights and tubes, although the navy had officially adopted both by 1819. In a similar fashion, the need for economy between 1815 and 1820 was to delay the implementation of other, more ambitious plans put forth during those years for improving naval gunnery, in particular plans for a gunnery training school. For the adoption of sights and tubes, significant as it was, counted for little unless accompanied by intensive instruction and training in handling guns as well as sights.

The Royal Navy had never made use of training ships or depots in instructing naval gunners. They did not as late as 1816 even possess a standard manual of exercise for working heavy guns, the crew of each ship being "more or less instructed

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1. W.O.44/936, Ordnance memo. 13 Nov. 1814. Adm.1/4023, Ordnance to Admiralty, 26 Feb., 30 April and 23 May 1817. Dupin, Military Force, i. 265. Ind. 4943: 98-21, 22 and 24 Jan. 1818; 4948: 98-21, 2 Feb. 1819; 4964: 98-21, 20 Feb., 27 Nov. 1822.

according to the ability and inclination of their officers."[1] With no gunnery school, no gunnery system, and all training varying in quality and quantity from ship to ship, it was not surprising that British gunnery was often unimpressive.

In fact the standard of British gunnery was low. It was low among the ships that had fought the Americans and it was low throughout the fleet. Shannon's exceptional gunnery was ~~as much~~ a rarity both in the fleet as a whole ~~as it was~~ and to that part of it on the North American Station. This fact was pointed out to Melville by "A Post Captain" (Sir Charles Napier) in case the First Lord should believe, as some did, that as the cream of the Royal Navy was occupied in Europe, inferior British gunnery in America was not a matter for grave concern.

Sir Charles conceded that the Mediterranean Fleet "to look at was the finest I ever saw." But its sailing was lubberly,

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1. Sir S.J. Pechell, Observations upon the Defective Equipment of Ship Guns (Corfu, 1825), pp. 12-13. See also Bowles, Pamphlets, pp. 48-49, and C. Lloyd, "The Origins of H.M.S. Excellent", M.M. xli. 193-97.

"and as for firing with precision, they knew nothing about it."[1] There was, as C.N. Parkinson has contended, considerable evidence to indicate that British gunnery was poor throughout the fleet, and had been since before Trafalgar, rather than having declined during the uneventful years between Trafalgar and the War of 1812.[2] What the Americans in fact had done, was to add the new dimension of long-range to naval warfare that was to have far-reaching effects on the science and technology of naval gunnery.

The American victories thus not only inspired the Admiralty to improve accuracy through the use of sights and tubes, they spurred an intense interest in gunnery training. Six months following the disasterous first encounters, Ordnance was studying "the American mode of loading guns."[3] In his report on the

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1. Napier, The Navy, p. 3. See also Ibid. pp. 6, 9. Napier, (1780-1860) was the hero of Cape St. Vincent in 1833. A brilliant eccentric, he showed early interest in steamers and strove to improve the Royal Navy. He commanded in the Channel in 1846, and in the Baltic in 1854, amid the controversy usually attending his activities.

2. Parkinson, Exmouth, pp. 412-15.

3. Adm.1/4021, Ordnance to Admiralty, 7 June 1813.

subject, William Cuppage of the Royal Carriage Department noted that the Americans, while training their gunners aboard ship in the English fashion, had "added previous instruction on shore in their several Forts, a practise most worthy of imitation."[1] The Admiralty, for their part, were most anxious to double the weekly quotas of exercise powder issued to ships. Owing to problems of stowage, Ordnance considered such an increase "not applicable to actual service."[2]

It was not until 1816 that the Admiralty took firm steps to introduce gunnery training into the Royal Navy. By Order in Council of November that year, the Royal Marine Artillery were instructed to train naval gunners.[3] Established in 1804 to replace men of the Royal Artillery serving on mortar vessels, the Marine Artillery in January 1816 was given a peace establishment of four companies and the additional task of drilling all Royal Marines in gunnery.[4]

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1. Ibid. 22 June 1814, enclosing Cuppage to Ordnance, 21 June 1814.
2. Add. MSS. 41367, R. Wellbank to R.H. Crew, 10 Aug. 1815.
3. Adm.1/5228, Order in Council, 25 Nov. 1816.
4. Adm.2/1214, Admiralty to Major General Sir Richard Williams, 23 Dec. 1815.

The Order in Council of November 1816 increased these four companies to eight, at a time when all other units were undergoing severe peace-time reductions, and increased their duties to include serving on ships other than mortar vessels. All rates received a number of Marines representing one-sixth to one-eighth of the ship's complement. The Marines were to assist in training sea gunners, "experience having proved the great advantages to be derived to the Service from this practice, which has been of late tried to a small extent."[1]

The Order in Council became effective in January 1817, despite protests from the Commandant of the Marine Artillery, Sir Richard Williams, that he was losing his artillery to the navy.[2] Under Admiralty orders, Marine Artillery field pieces were replaced with naval guns and carriages at Portsmouth,

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1. Adm.1/5228, Order in Council, 25 Nov. 1816. Adm.2/1220, Admiralty to Commanders of Royal Marines, 21 Jan. 1819, with printed enclosure.

2. Adm.2/1216, Admiralty to Sir Henry Bell, 9 and 16 Dec. 1816.

Plymouth and Chatham.[1] In the first instance these three companies were to train the regular marines ashore and on board ship, and the commanders of Marine Divisions were ordered not to employ the Marine Artillery in any way "that may impede or delay the intended instruction."[2]

Thus the means of training sea gunners had been determined. Although it seems clear that the marine Artillery were to provide only the nucleus of skilled gunners for the navy, the exact method by which they transmitted gunnery skills to naval personnel is not apparent. Whether in fact they trained the sailors directly, or served only their own guns was quite possibly left to the discretion of the individual ship's captain. In either case, the existence of two separate groups responsible for naval gunnery increased the need for one uniform

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1. Adm.2/1217, Admiralty to Sir Henry Bell, 21 March 1817; to Ordnance, 9 and 21 May 1817; to Commanders of Royal Marine Divisions, 9 May 1817. See also Adm.2/1218, fos. 299, 315, 327, 392-93, 525; 1219, fos. 305, 467; Adm.1/4024, Ordnance to Admiralty, 1 June 1818.

2. Adm.2/1217, Admiralty to Commanders of Royal Marine Divisions, 9 May 1817.

system of operating naval guns.

The Admiralty viewed with alarm "the diversity of the modes of Discipline and Exercise ... which has hitherto prevailed ... with considerable injury" to the Royal Navy. With the intention of establishing "an uniform Practice of Exercise throughout the Navy ...", sixteen flag officers and captains were convened at the Admiralty on 16 June, 1817.[1] By the end of the month, the chairman, retired Admiral Sir William Young, submitted the proposed system to the Admiralty. The system recommended the numbering of every step in loading, aiming and firing guns, and assigned specific duties to each member of the crews. In this respect it was no different from the many similar but unofficial systems that prevailed in the navy. The significant fact was that it claimed to embody the best features of all known systems, and if approved by the Admiralty, it would become standard throughout the fleet.[2]

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1. Ind.4938:59-4, 11 June 1817.
2. Adm.1/587, Admiral Sir William Young to Admiralty, 27 June 1817. This system was in fact the one adopted by the Royal Marine Artillery in 1807.

This approval was given in August 1817, even before favourable reports on the system arrived from the captains of Florida and Queen Charlotte.[1] In no uncertain terms the Admiralty expressed the importance they placed on such a system:

> And whereas we consider the uniformity, celerity and precision of the Great Guns to be vitally important to the Honour of His Majesty's Arms and to the Safety of the Country, we do most strictly and earnestly command and enjoin all Officers to pay, according to their several Ranks, the greatest attention to this subject, and to spare no exertion in training the Seamen and Royal Marines to an uniform, quick and precise practise of the Great Guns agreeably to the said Instructions.

Only by using this system, "and no other", could the crew of one ship be capable of co-operating immediately with that of another, or with the Royal Marines and Royal Marine Artillery. In this way, a higher standard of gunnery could be attained, and a large reservoir of skilled gunners created.[2]

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1. Ind.4938: 59-4, 26 Aug., 6, 7 and 21 Oct., 29 Nov. and 8 Dec. 1817.

2. Adm.2/1220, Admiralty to Sir Henry Bell, Commandant in London of the Royal Marines, 7 Nov. 1818, enclosing printed copy of Instructions for the Exercise of the Great Guns (London, 1818), preface.

The Admiralty's desire to improve naval gunnery encouraged naval and artillery officers to submit almost a dozen similar gunnery systems within a two year period.[1] The original system was retained, however, and in 1818 one thousand abstracts of the original twenty-four-page manual were distributed to all Royal Marine Commandants and Naval Station Commanders for further dissemination.[2] Like the Admiralty's system, the other schemes submitted for study were concerned with the mechanical procedure of loading and discharging the guns. A more ambitious plan for a "Corps of Naval Gunnery" was, in 1817, suggested by a retired artillery officer teaching at Sandhurst. This officer was Colonel Sir Howard Douglas. So pervasive was this man's influence on the evolution of naval gunnery during the first half of the nineteenth century, that his career deserves close study.

Douglas was the son of Admiral Sir Charles Douglas, Rodney's fleet captain at the Battle of the Saints. Sir Charles had been the first to use flintlocks on heavy artillery, and

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1. Ind.4938: 59-4, 7, 21 July, 15, 21 and 23 Oct., and 27 Dec. 1817; 4942: 59-4, 12 Aug. 1818; 4947: 59-4, 9 March 1819.

2. Ind. 4942: 59-4, 22 Nov. 1818. Adm.2/1220, Admiralty to Sir Henry Bell, 11 Feb. 1819.

had suggested in vain the adoption of gunsights and vent tubes to improve the navy's gunnery.[1] He died in 1789 on his way to command the North American Station. The following year, at the age of fourteen, his son Howard entered the Military Academy at Woolwich, graduating 1 January 1794 as a second lieutenant in the Royal Artillery.[2]

His first stationing was at North Tynmouth, but in 1796 he was transferred to Canada. Shipwrecked at Great Jarvis, Labrador, he survived to serve at Quebec and Kingston.[3] On the death of his half brother, Douglas became Third Baronet of Carr, and in 1799, while still on compassionate leave in Edinburgh, married Anne Dundas. It is probable his wife's influential

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1. On Sir Charles Douglas's many proposals for improving naval artillery, see Douglas, 3rd. ed., p. 458; Robertson, pp. 150-54, Majendie, Smooth-bore Ordnance, pp. 129, 191-92; W.O.44/498, Admiralty to Ordnance, 9 April 1816. It is quite probable that Douglas compiled the manuscripte entitled "A Treatise on Artillery", dated 1780(?), and initialed C.D., contained in W.O.55/1823.

2. S.W. Fullom, The Life of General Sir Howard Douglas (London, 1863) is an enthusiastic but not always accurate biography of Douglas.

3. W.O.55/1064, Deputy Adjutant of Artillery to Lord Dorchester, 4 Jan. and 15 April 1796.

connections prevented ~~his~~ him from having to return to Canada, as "he would rather be employed anywhere than go back to that country."[1] His next five years were spent with Royal Artillery battalions at Plymouth, Woolwich and Canterbury.

From November 1803, until April 1804, Douglas served with the experimental rocket and mortar battalion of the famous William Congreve. His first inventions, a flintlock for sea mortars and a device for ascertaining when the mortar's base was horizontal, were produced during this posting.[2]

Through his "talents as a mathematician and knowledge in the scientific parts of his profession", Douglas in the summer of 1804 was appointed Superintendent of the Senior Department of the new Royal Military Acadamy (Sandhurst).[3] His immediate superior,

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1. W.O.55/1067, Lieutenant Colonel Thomas Trotter to the Deputy Adjutant General of Artillery, 2 April 1799.

2. W.O.55/1148, Deputy Adjutant General of Artillery to Sir William Congreve, 8 Nov. 1803 and 20 April 1804: W.O.55/1079, Captain Alexander Munro to D.A.G., 6, 9 and 18 May 1804, and D.A.G. to Munro, 25 May 1804.

3. W.O.40/10, Sir Harry Calvert to Earl Cavan, 11 March 1805; W.O.133/13, Sir Robert Brownrigg to General Sir John Moore, 7 Dec. 1808.

the French Royalist General, Jarry, was senile and spoke little English, so that the burden of running the department was assumed by Douglas. In two years Douglas replaced Jarry, becoming acting commandant of the Senior Department with the rank of Lieutenant Colonel.[1]

Much bitterness was caused by Sir Howard's original appointment and subsequent promotion. Both General Jarry and the Lieutenant Governor of the Academy, Colonel John G. LeMarchant, resented Douglas. Following Jarry's "retirement", LeMarchant found himself "surrounded by strangers", and experiencing difficult relations with both superiors and subordinates.[2]

1.W.O.31/220, William Harcourt to Commander-in-Chief, 28 Dec. 1806. Major A.A. Godwin Austen, The Staff and the Staff College (London, 1927), pp. 37-39.

2. Some indications of this bitterness are to be found in LeMarchant's letter books at Sandhurst. See in particular R.M.A.S. 3, LeMarchant to Sir Harry Calvert, 22 March 1804, to General Stuart, 26 June 1806, to the Earl of Harrington, 16 Aug. 1806, and to General Clinton, 8 April 1807. See also Minutes of the Supreme Board of the Royal Military Academy, W.O.99/5/2, 23 Nov. 1804; W.O.99/6/3, 2 Aug. 1806.

In this unhappy situation, Douglas volunteered for active duty, a request highly applauded by LeMarchant and warmly welcomed at the Horse Guards, where both the Commander-in-Chief and the Quarter Master General of the Army were anxious to improve the standards of the Senior Department by exposing its young commandant to actual service.[1] Recommended to Sir John Moore as "an artillery officer (who) is allowed to excel most of his standing", Douglas was sent to observe the functioning of the higher departments of Moore's army. His object was "soley to acquire knowledge."[2]

Douglas arrived in the Peninsula too late to observe a great deal, as Moore's retreat had begun before the former's departure from England. But in the summer of 1809, Douglas was sent out once again to gain experience, this time at the siege of Walcheren. This campaign, too, was a defeat for British arms,

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1. R.M.A.S. 3, LeMarchant memo. 18 Nov. 1808. W.O.133/13, Sir Robert Brownrigg to Douglas, 11 July, 1808. Godwin Austen, Staff College, p. 50.

2. W.O.1/639, Commander-in-Chief to General Moore, 15 Dec. 1808; W.O.133/13, Sir Robert Brownrigg to General Moore, 7 Dec. 1808, to Lieutenant Colonel George Murray, 10 Dec. 1808.

but it provided the acting Commandant of the future Staff College with a longer opportunity to observe staff officers in action.[1]

Douglas learned a great deal at Walcheren. In the first place, earlier criticisms that his department was not providing officers with sufficient training in the making and interpreting of maps were borne out. On his return to England, Sir Howard immediately drew up a more practical surveying course, devoted more time to field work and instruments experience at the expense of fortification classes, and suggested a new scale of four inches to the mile in military maps. In all these proposals Douglas was opposed by LeMarchant. But the governor of the college and the supreme board overruled LeMarchant, and Douglas's suggestions were put into practice. Around the same time he patented the Douglas reflecting circule for the improvement of surveying instruments.[2]

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1. W.O.1/641, Commander-in-Chief to Brownrigg, 7 July, 1809.

2. R.M.A.S. 7, LeMarchant to Douglas, 2 Aug. 1810, 14 Feb., 20 and 31 March, 7, 11 and 13 April 1811; to Harcourt, 18 and 20 Feb. 1811. W.O.99/6/4, Minutes of the Collegiate Board of R.M.A.S., 17 May 1811.

In August 1811, LeMarchant left the Academy to command a cavalry regiment, soon followed by Douglas who was to serve as British Agent in the north of Spain, with headquarters in Gallicia.[1] He undertook to report on the Spanish guerilla activities against the French, advising and supplying the guerillas as well as British frigates and gunboats on the coast. During the first months of 1812, under Wellington's orders, Douglas directed guerilla diversionary tactics in the course of which he had a sharp difference with Wellington.[2]

Douglas had protested strongly to the local Junta when that group prepared to send twelve hundred soldiers and their British equipment to South America. Wellington rebuked Douglas for having offended the Junta when they had no alternative but to obey the orders of their central government. He intimated to Lord Liverpool, Secretary for War, but soon to be Prime Minister, that Douglas be replaced.[3]

Douglas had nevertheless succeeded in keeping both troops

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1. W.O.6/43, Lord Liverpool to Douglas, 30 July 1811; W.O. 99/6/4, Minutes of the Supreme Board of R.M.A.S., 2 Aug. 1811.

2. Douglas's correspondence on his activities in Spain is to be found in W.O.1/261-63.

3. W.O.1/261, Douglas to Liverpool, 18 Oct. 1811; W.O.1/254 Wellington to Liverpool, 6 May, 1812.

and equipment in Spain,[1] a fact that did not placate Wellington. Moreover, Wellington's desire to jettison Douglas in May of 1812 was complemented by the even stronger desire of the Royal Military Academy to have him return. In December 1811, the Supreme Board of the Academy demanded Douglas's return. When the Secretary of State refused, the Board protested that the condition of the Senior Department did "absolutely depend on Sir Howard Douglas's immediate return."[2] In May 1812, Douglas was very reluctantly "replaced after performing his duties to the perfect satisfaction of His Majesty's Government."[3] Although the reason given was the "repeated and earnest" requests of the college for his return, Douglas did not return to England until November. He spent the summer in various parts of Spain with the guerillas, and aboard the North Coast Squadron of Sir Home Popham.[4]

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1. W.O. 1/267, Douglas to Colonel H.E. Bunbury, 17 Jan. 1813.
2. W.O.99/6/4, Minutes of the Supreme Board of R.M.A.S., 19 Dec. 1811 and 30 Jan. 1812.
3. W.O.6/43, Bunbury to Douglas, 15 May 1812.
4. W.O.1/263, Sir Home Popham to Lord Keith, 21 June 1812; Douglas to Popham, 2 Aug. 1812, and to Lord Liverpool, 19 July and 22 Aug. 1812; R. Bourke to Lord Bathhurst, 22 Oct. 1812. N.R.S. Keith, iii. 259-313.

On his return Douglas discovered that the Senior Department had been moved to Farnham. He assumed responsibility for setting up the future Staff College in its new location, and was promoted from "acting" commandant, as he had been styled since 1806, to commandant. He was also made Inspector General of Education for all military schools.[1] But in November 1816, Douglas's department was subjected to severe peace-time reductions. With little money available and few students to instruct, Douglas was free to turn his attention in other directions.[2]

That he turned to naval gunnery was perhaps surprising in light of his background as an artillery officer and army instructor. Yet when one recalls Douglas's admiration for his sailor father, his experience with naval mortars, his presence at Walcheren and off the north coast of Spain, there is little doubt but that he had had many opportunities to observe the standard of British naval gunnery. His acknowledged brilliance

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1. W.O.99/7/5, Minutes of the Supreme Board of R.M.A.S., 12 Jan., 1 Feb and 14 April 1813. See Godwin Austen, pp. 53-58.

2. W.O.99/7/6, Minutes of the Supreme Board of R.M.A.S., 4 Nov. 1816. Godwin Austen, pp. 59-60.

as an artillerist made him a competent judge of what he had observed.[1]

But it is doubtful if Douglas would have tackled the subject of naval gunnery had not the "late unfortunate affairs"[2] on the Great Lakes in 1814 forced his attention back to these recent observations. In October of that year he expressed his concern of British setbacks to Lord Liverpool.[3] In 1816 he submitted twin flintlocks for trials, and in 1817 commenced the argument for a reduction in windage. During the same year he submitted to the Admiralty an exhaustive treatise on all aspects of naval gunnery.

Douglas showed his first interest in improving naval gunnery in 1816, when he suggested an improved flintlock for naval guns. As single-flint locks were liable to failure, Douglas hoped to improve the reliability of ignition by providing two flints in place of the customary single flint. Should the

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1. Douglas, 1st ed., vii, pp. 1-3. N.R.S. Keith, iii. 259 and note.

2. Add. MSS. 38260, Douglas to Liverpool, 24 Oct. 1814.

3. Ibid.

first flint fail, a winged nut need only be turned 180 degrees to automatically centre the second flint in the correct striking position. The Admiralty ordered this lock gradually introduced into service, but owing to several factors, one of them being the need for economy, it was never actually adopted.[1]

In addition to improving ignition, Douglas further suggested that gun accuracy could be greatly improved through a reduction in windage. Windage was the term applied to the difference between the diameter of the gun's bore, and the lesser diameter of the shot meant to fit it. This gap was necessary to permit easy access of the shot when loading the gun. But allowance had also to be made for expansion of the shot by the white heat of the discharge, for its enlargement through rust, for the fouling of the gun during heavy fire, and for the thickness of tin straps generally used to attach the shot to a wooden bottom. Finally, considerable allowance had always been made for

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1. Adm.1/4023, Ordnance to Admiralty, 10 Nov. 1816, enclosing Douglas to Ordnance, 8 Nov. 1816. See also Douglas, 1st ed., pp. 207-10, and Majendie, Smooth-bore Ordnance, pp. 191-92.

imperfectly cast shot or bore.[1]

In June 1817, Douglas was primarily concerned with the last feature. The improvements in casting during the past twenty years, he informed Wellington, had rendered unnecessary such a large windage as British guns possessed. Douglas claimed that one-quarter to one-third of the gunpowder's force escaped around the projectile; this not only served to reduce range, but accuracy was impaired by the shot's tendency to traverse the large bore in "a sort of zig-zag motion." Thus if the shot last deflected from the left of the bore, it veered right of the target.[2]

Douglas was convinced that if this large windage was not reduced, the adoption of gunsights and vent tubes would not appreciably improve the accuracy of British gunnery. The gun itself was inaccurate. Moreover, he pointed out, it was less accurate in this respect than were the guns of France or America. The windage of a French 24-pdr. was .133 inches, that of the

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1. Douglas, 1st ed., pp. 69-95. Majendie, pp. 110-15.

2. Adm.1/4024, Ordnance to Admiralty, 21 Jan. 1819, enclosing Douglas to Ordnance, 18 June 1817. Douglas 1st ed., p. 70.

same American gun slightly larger. Most British 24-pdrs., on the other hand, had a windage of .277 inches, more than double that of French counterparts. Douglas recommended that windage in all heavy artillery be reduced to .14 or .13 inches.[1]

Such a reduction had been advocated in the 1770's by Dr. Charles Hutton at the Ordnance Department, but never carried out.[2] Despite the success of the carronade after 1779, a success that owed much to its having a windage half that of the same calibre gun,[3] little had been done about Hutton's suggestions until 1811. In that year, Sir Thomas Blomefield, the Inspector of Artillery, experimented with enlarged shot to determine the

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1. The windage of British Artillery was established at 1/20 the diameter of the shot. 24-pdr. shot having a diameter of 5.547 inches thus had a windage of 1/20 x 5.547 or .277 inches. A 32-pdr. had a windage of .300 inches. See Douglas, 1st ed., p.69.

2. Robertson, Naval Armament, pp. 128-29. Paixhans, Nouvelle Force, p. 12, note. Simmons, Effect of Heavy Ordnance, pp. 5-6, 42-46.

3. 24-pdr. guns and carronades had windages respectively of .277 and .140 inches, 32-pdrs. had .300 and .150 inches. Douglas, 1st ed., p. 69.

benefits of reducing windage, but did not consider the resulting improvement in range and accuracy sufficient to justify the increase risk of gun bursts that he predicted would accompany a reduction in windage.[1]

Douglas's suggestions in June of 1817 renewed official interest. In June 1818, enlarged shot was fired from 6-, 9- and 12-pdr. guns at Woolwich. Even with reduced powder charges to prevent gun bursts, the heavier shot's range and accuracy were superior to those of regulation shot fired from the same guns. The committee recommended that guns of small calibre have a standard windage of .1 inch, and further recommended that 24-pdrs. undergo similar trials.[2]

A month later these trials had been completed. It was discovered that, as with the lighter guns, reducing the 24-pdr.'s

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1. Adm.1/4024, Ordnance to Admiralty, 21 Jan. 1819, enclosing report of the President of the Select Committee, General Anthony Farrington, to Ordnance, 18 July 1817.

2. Ibid. 21 Jan. 1819, enclosing Farrington Report to Ordnance, 12 June 1818.

windage not only improved range and accuracy, but actually reduced wear in the bore, thereby prolonging the gun's life. A windage of .15 inches was recommended for all heavy artillery.[1]

These alterations were adopted by the Royal Artillery. But the Admiralty, after first accepting the recommendations, held back when a committee of naval officers under Lord Keith advised against reducing windage in naval guns. The committee believed nothing should be done until the effects of corrosion on sea shot were more closely studied. The Woolwich Select Committee of artillery officers who had actually conducted the trials, concurred in this opinion, and further pointed out that as enlarged shot would not fit the smaller bores of carronades, two sizes of sea shot would have to be supplied for guns and carronades of the same nominal calibre.[2]

Douglas retorted that rust could easily be avoided by lacquering naval shot, while the second problem, that posed by

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1. Ibid. 21 Jan. 1819 enclosing Farrington Report of 18 July 1818. See also Douglas, 1st ed., pp. 79-86.

2. Adm.1/4024, Ordnance to Admiralty, 21 Jan. 1819, enclosing Farrington to Ordnance, 18 Jan. 1819. Ind.4947:59-4, 21 Jan., 16 and 23 Feb., 4 May 1819.

carronades, could be solved by reaming out these weapons an average of only .07 inches.[1] Both these steps were ultimately taken. But in 1819 the Admiralty were "decidedly of the opinion that not any alteration should be made."[2] The problem of excess windage remained unsolved until 1839, a fact that did much to counteract the efforts made in other directions to improve the accuracy of naval gunnery.

Sir Howard had thus failed to have either his new flintlock or his proposed reduction of windage accepted. He was to have little better success with the many suggestions made in the exhaustive treatise on all aspects of naval gunnery that he submitted to the Admiralty in 1817.[3] The treatise began by comparing

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1. Douglas, 1st ed., pp. 86-91; 3rd ed., pp. 114-27.

2. Ind.4947: 59-4, 4 May 1819. Paixhans suggested that French windage, which was about half that of English artillery, could be safely reduced. Nouvelle Force, pp. 190-92, 198, note; Expériences Faites par La Marine Francaise sur une Arme Nouvelle, (Paris, 1825), pp. 80-84.

3. Adm.1/4525, Douglas to Admiralty, 15 and 23 Oct. 1817 and enclosures. Although the manuscripts are not identical with the material later published, future references are drawn from the published form.

Britain's cussess in Europe with her failure in America; Douglas concluded wryly that British gunnery superiority had "consisted more in relative than in absolute excellence."[1] He further concluded that this state of affairs reflected the fact that, deplorable as British gunnery was, European gunnery was even worse; the close-range rapid-fire tactics that had triumphed in Europe "through being feebly opposed" had proven inadequate against American long-range skill.[2] Douglas believed the Royal Navy could also attain such skill if, to the superior quality of its seamanship and ordnance "the knowledge of warlike science and practice be added."[3] To acquire this knowledge and practice would require the provision of a manual of exercise and a gunnery training school.

It will be recalled that in 1817 the Admiralty had adopted such a manual, and had also re-organized the Royal Marine Artillery into a training unit for naval gunners.[4] Douglas had

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1. Douglas, 1st ed., pp. 3.
2. Ibid.
3. Ibid. pp. 7-8
4. See above.

also included a manual in his treatise, but was indifferent as to whether the Admiralty adopted his system or one of the many others submitted to them. "The mere arrangement of a manual," he explained, would provide "very trifling progress" in gunnery. it was a necessary first step, but if it was to be an effective one, a permanent school of gunnery would be required.[1] It was on this point that Douglas was most critical of Admiralty policy.

He realized that it had been "no uncommon thing" for captains fitting out ship to employ the Royal Marine Artillery to train their sea gunners.[2] This had been bad enough, Douglas believed, but to use the marines to the extent envisaged in the 1816 Order in Council, would "repress and extinguish an ambition now very general among naval officers, to make themselves masters of this important part of their duty."[3] If the Royal Artillery

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1. Douglas, 1st ed., p. 143. The manual is included Ibid. pp. 145-93.

2. Ibid. p. 25. See pp. 11-30 for Douglas's discussion on the use of the Marine Artillery.

3. Ibid. p. 15. Other observers, notably Bowles, p. 48, and Napier, Navy, pp. 1, 3-4, 12-16, remarked on the need and general desire for a gunnery training school at this time.

and the Royal Marine Artillery had their training depots, it would be sensible for the Navy to take advantage of this new enthusiasm in its officers to provide at least one such depot.

Douglas anticipated that even one small depot could provide a nucleus of master gunners who would join the fleet and pass on their skills to other sailors. Not only would this serve to support "the uniform, systematic excellence of the whole machine, however remote some of its parts may be," but a purely naval establishment would give rise to an _ésprit de corps_ that would encourage emulation and a pride in gunnery.[1]

Sir Howard envisaged a depot consisting of a shore range for preliminary training, a hulk for introducing the difficulties of gunnery at sea, and finally, a sea-going vessel to give the full experience of operating ship and gun at the same time. At this depot gunners would also study the theory and mechanics of all projectiles and ordnance in service, and carry out experiments with new inventions.[2]

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1. Douglas, 1st ed., p. 24.
2. _Ibid._ pp. 15-24.

Trifling as Douglas's scheme might sound, he was in fact suggesting an organization that had had very little precedent. Although the Spanish had set up a fleet gunnery school as early as 1576, it was of small influence, short duration, and was probably made up of army personnel.[1] Not for another two centuries was any attempt made by any power to systematically train naval gunners. This occurred in 1767 when the Duc de Choiseul, French Minister of Marine and Colonies, provided for organizing ten thousand naval artillerists to drill once a week at the various ports. These were not, however, sailors, and after 1783 even this training ceased.[2] During the War of 1812 the Americans had trained first on shore and then at sea, where, with their large complements, a good portion of the crew was free for gunnery practice at a given time. Yet the Americans did not have a school of sea gunners.[3]

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1. N.R.S. Monson, iii. 323-24.

2. Mahan, p. 333. Douglas, 1st ed., p. 2, points out that British ships had taken their greatest punishment from the French at this period.

3. Adm.1/4021, Ordnance to Admiralty, 22 June 1814, enclosing William Cuppage to Ordnance, 21 June 1814. Clowes, vi. 53. See also Dahlgren, Shell-Guns, prefatory note, p. 13.

In 1815 the French had been even more anxious than the British to follow the American example of good gunnery. By Règlement of that year, a manual of exercise was promulgated, and plans made for once more training sea artillerists at the various ports.[1] Indeed it was the French manual that Douglas had included in his treatise. The Admiralty's activity of 1817 was similar to that of France. A manual had been adopted but the training of naval gunners was not to be given by the navy, but by the Marine Artillery.

Douglas, on the other hand, was recommending something quite new and quite different. He wished to see an elite group of men within the Royal Navy responsible for gunnery training. Only a group with special status and pay, and possessing the "ésprit de corps" found in graduates of the same institution, could provide the impetus necessary to raise the standard of gunnery.

Sir P.V.B. Broke, revered captain of the Shannon, was a

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1. Douglas, 1st ed., pp. 2, 145, 188, note. By 1820, upwards of 5000 gunners of the French artillery and marine artillery were available for service aboard French ships. F.C.P. Dupin, Organisation de la Marine et des Colonies (Paris, 1834), i. 181-85.

"most anxious well wisher" of Douglas's plan. Even one small depot would, he agreed with Sir Howard, "create an excellence that will excite emulation."[1] Another gunnery expert and veteran of the War of 1812, Captain S.J. Pechell, also applauded Douglas's work. Having transmitted a copy of Douglas's manuscript to Broke in the hope that he would use his prestige to press for official action on its suggestions, Pechell mourned the fact that Broke, "did he reside in London", could have exercised immense influence.[2]

Broke made little effort to exercise this influence. He did, however, lament the fact that "after the useful lessons which the late war afforded us", the Admiralty had rejected Douglas's scheme for a corps of naval gunners. "It will be too late to teach our hands to war," he wrote Douglas, "when the enemy is pillaging our trade and Lloyd's in an uproar to have ships rigged and sent instantly to sea." He advised Douglas to

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1. Douglas, 3rd. ed., pp. 12-13, notes, personal letters of Broke to Douglas, 5 July and 23 Sept. 1818.

2. Ibid. Pechell to Douglas, undated.

publish.[1]

The Admiralty had turned down Douglas's plan for a training ship on the plea of "political circumstances and financial considerations." They did, however, "highly approve of the work", retained a copy for their own reference, and granted Douglas permission to publish. The first edition of Naval Gunnery, appeared in 1820.[2]

Douglas's book represented yet another advancement in gunnery resulting from the War of 1812, an advancement that was to contribute much to the "knowledge of warlike science" its author advocated and which was so lacking in the navy. Indeed, not since the seventeenth century had a similar treatise been published in England.[3] With the exception of Adye's small, general handbook, Bombardier and Pocket Gunner, Britain possessed

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1. Ibid. Broke to Douglas, 23 Sept. 1818 and 3 Jan. 1819.
2. Ind.4947: 59-4, 24 Feb. 1819. Douglas, 3rd. ed., p. 20.
3. John Seller, The Sea Gunner (London, 1691).

no textbooks in the field of naval gunnery.[1] And although not officially adopted as a textbook until much later, Naval Gunnery did much to fill this need. It exercised a tremendous influence on the thinking of those interested in its subject. Translated into French, Dutch and Spanish, and widely read in the United States, the many suggestions made in Douglas's book were ultimately adopted by all navies.

Naval Gunnery was the first serious study into the problems of naval armaments in the new, scientific era initiated by the Americans. As such it was symptomatic of the Royal Navy's transformation from a completely unsophisticated approach to gunnery in 1812, to something approximating a scientific and precise approach by 1820. This transformation had brought about the adoption of gunsights and vent tubes, gunnery manuals and gunnery training, in an attempt to attain the accuracy

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1. The paucity of British texts was noted by Dupin, Voyages, ii. ii. 30. Only the infantry and the cavalry were issued with standard manuals. Glover, Peninsular Preparations, pp. 90-91.

demonstrated by the Americans in the War of 1812. The British had also adopted super frigates, and had replaced many of the 18-pdrs. in the navy with Congreve's 24-pdr. medium ship gun. The eighteen twenties were to witness the continuation of this tendency towards heavier ships and armaments, together with an attempt to standardize both.

Chapter Three

THE EIGHTEEN TWENTIES: STANDARDIZING THE SAILING NAVY

By using gunsights, vent tubes and systematic gunnery, the Americans had served as an example to Britain. Yet in one respect, that of size of ship, the Americans were not innovators as they had been with gunnery. In building frigates larger than comparable European vessels, they had merely emphasized a trend towards heavier ships and armaments already observable in Europe. This trend had witnessed the supplanting of the 12-pdr. gun by the 18-pdr., with subsequent enlarging and strengthening of warships. The American 24-pdr. guns and super frigates instigated further desire for even heavier ships and armaments after 1815. The British move to 24-pdr. Congreve guns was rendered ineffective by France's adoption of 30-pdr. uniform calibre, and the American move to the 42-pdr. forcing Britain once more to introduce heavier artillery in the form of 32-pdr. uniform calibre, thus bringing the wooden sailing ship of the line to its apogee in size and power.

In the peace following 1763, the French and Spanish rebuilt their shattered fleets. The victorious Royal Navy carried on largely with existing ships. Lord North's refusal to grant additional naval estimates between 1772 and 1778, on the grounds that large peace establishments would, "if we do not take care, prove our ruin," had considerable bearing on Britain's loss of the seas during the American Revolution;[1] for the patched-up 50- and 64-gun ships of 1763 were, in 1778, opposed by European counterparts mounting 64 and 78 guns.

After 1783 Britain took steps to improve her Navy. Not only was attention paid to artillery and gunpowder, considerable effort was made to bring British ships up to European standards. The 50-gun ship was discontinued and neither the popular 64 or 74 of the eighteenth century was considered sufficiently powerful to serve in the line.[2]

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1. N.R.S. Sandwich, 1. 19-26, 201, 235-45, 327-35. Bartlett, Sea Power, pp. 1, 3. Sir H. Richmond, Statesmen and Sea Power (Oxford, 1946), p. 136.

2. Albion, Forests and Sea Power, pp. 390-91. Bowles, Pamphlets, pp. 27-33.

The 74, the smallest ship in the line of battle in 1793, was replaced in that year by the French with the 82, thereby increasing broadside weight of metal by nearly five hundred pounds.[1] The Royal Navy also considered the 74 too small for the line, but found it too useful for other purposes to abandon entirely. This class served well enough on blockade duty, and was otherwise valuable in shallow waters such as the Baltic. Several of one type of 74, the scornfully and durably nicknamed "forty thieves", were cut down to such heavy frigates, amounting 24-pdrs., as the Barham, Anson, Magnanime and Indefatigable. Others of the same class stayed on until the 1830's, devouring valuable dockyard space, and attracting the scorn of naval critics.[2]

There were other increases in the size of ships and armaments

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1. Dupin, Voyages, ii. ii. 156-57. Paixhans, Nouvelle Force, p. 55. See also Add. MSS. 41399, Martin to Sir James Graham, 22 Jan. 1831.

2. Bartlett, Sea Power, p. 36. Bowles, Pamphlets, pp. 6, 42-43, 67-69. Napier, The Navy, pp. 64-66. Sir J.H. Briggs, Naval Administration: 1827-92 (London, 1897), 10-24. Add. MSS. 41399, Martin to Graham, 22 Jan. 1831.

during the Napoleonic Wars. The British 36- and 38-gun frigates had been given increased broadside weight by the addition of 24-pdr. carronades on their quarter decks and forecastles. Even so, such 32's as Thames, Isis, Boston and Venus, with main battery armaments of 12-pdr. guns, were embarrassed by French counterparts mounting 18-pdrs. Steps were subsequently taken to make the 18-pdr. the smallest main battery armament on British frigates.[1]

As a result of this step, similar increases in standard armament were introduced into ships of the line. As multi-decked ships could not fight their lower deck guns in rough seas, the general practice was to arm the upper decks with the same calibre gun prevailing among frigates.[2] By 1811, all upper decks were to carry at least 18-pdr. guns. Those ships that could not support the heavy nine- or eight-foot patterns were to receive a very light six-foot gun.[3] Nevertheless, the trend was toward

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1. Adm.7/677, Establishments of Ordnance, Admiralty Orders of 14 Dec. 1779, 25 Nov. 1782 and 4 June 1799. Bowles, Pamphlets, pp. 27-33.

2. Dupin, Voyages, ii. ii. 150.

3. Adm.1/4020, Ordnance to Admiralty, 13 Feb. 1811.

heavier armament weight, leading to larger ships of the line.

This "increased dimensions of men of war," Sir Robert Seppings, Master Shipwright at Chatham Dock Yard, informed the Admiralty, "calls for increased strength."[1] In the interests of added strength, Seppings had advocated in 1807 that traditional beakhead bows be replaced in large ships by a round bow. The _Defence_ and _Vindictive_ had been constructed on this principle, and had proved Seppings' contention that round bows would provide increased strength and stability, while giving greater protection to the crew and providing room for chase guns. In 1811, the year 18-pdr. guns were introduced on all upper decks, the Admiralty officially adopted the round bow.[2]

In that same year, Seppings submitted further proposals to strengthen ships against their increased burden of size and armament. He wished to give them stronger frames. Traditionally, a ship's frame consisted of horizontal and vertical beams meeting at right angles. The space enclosed by these beams was, therefore,

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1. Adm.7/709, undated manuscript of Sir Robert Seppings, fo.2.
2. _Ibid_. fos. 54-55, Dupin, Voyages, ii. ii. 162-63. Robertson, _Naval Armament_. pp. 53-54.

of rectangular shape. Hence the frame was essentially weak, as weight and stress tended to distort the unit cell from a rectangular to a rhomboid shape. From the picture of a Swiss bridge, Seppings derived the idea of adding a diagonal brace to each unit cell. This "trussed frame" transformed the cell from a weak rectangle into two immovable triangles.[1]

Not only was this new structure inherently stronger, the "triangular mode" of construction insured that stress would follow the grain of the timber, rather than cut across it, and would be distributed throughout the whole structure, not borne only at the point of strain, as was the case in the old style. The new construction was thus estimated to treble the strength of a ship, and increase her stiffness six times. As a result,

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1. The references for this and the four subsequent paragraphs are: Sir Robert Seppings, On a New Principle of Constructing His Majesty's Ships of War (London, 1814), A letter Addressed to the Right Honourable Viscount Melville on the Circular Sterns of Ships (London, 1822), Seppings manuscript in Adm.7/709, fos. 1-68; also Dupin, Voyages, ii. ii. 162-63, and De la Structure des Vaisseaux Anglais, Considérée dans ses Derniers Perfectionnements (London, 1817). Albion, pp. 393-94. Bartlett, pp. 34-36. Robertson, pp. 50-56.

"arching", the tendency of bows and sterns to droop as they were relatively less supported by the water than amidships, was reduced. So, too, was "hogging", the similar tendency across the breadth of the ship owing to the weight of her guns.

In February 1811, the Tremendous, a 74 built on Seppings' principle, was launched and proved successful. The larger ships Ramillies and Albion were similarly rebuilt at Chatham, and nine new vessels laid down. Not only were these vessels demonstrably stronger than their predecessors, they represented a saving in valuable timber. Old or inferior timber could be used for the trussing, thereby saving nine thousand feet of first grade timber, or the equivalent of nearly two hundred oak trees in each ship of the line.

Having strengthened the bows and frames of ships, Seppings prescribed a similar treatment for sterns. He had encountered little "bigotry of old practice" in introducing his round bows and trussed frames. But when he attempted to extend these same principles to sterns, structurally and defensively the weakest part of the old ships but quarters of high-ranking officers, his suggestions caused a furore.

The Surveyor drew up a massive list of British ships that had leaked dangerously owing to loosened square sterns, or had sustained heavy damage from enemies hanging on the quarter, the point of impunity.[1] Under such circumstances, British captains had been known to blast out their own sterns with cannon fire in order to bring guns to bear on their tormentors.[2] Seppings pointed out that the advent of maneuverable steam gunboats would increase the risk resulting from the lack of a protective arc of fire at this vulnerable point. The Americans had already tried such a gunboat against one of their own frigates with great effect. With rounded sterns, however, a first-rate could direct ten, a frigate four guns, on any point astern.[3]

However cogently Seppings argued that square sterns were structurally and defensively weak, his round sterns were questioned "with a keenness and severity of a very uncommon

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1. Seppings, Letter to Melville, pp. 9-14.
2. Barnaby, Naval Development, pp. 22-24.
3. Seppings, Letter to Melville, pp. 10, 15-16.

kind."[1] Much of this criticism was directed toward the inconvenience of the water closet, and the small size of the captain's cabin. Seppings conceded the truth of these charges, and also admitted that round sterns were comparatively ugly, but he hoped that the merits of strength and protective arc of fire would prevail over the desire for sterns to resemble "shops in the Boulevards of Paris."[2]

Nevertheless, many officers were not pleased with the one iron balcony gracing the Admiral's cabin on the Prince Regent building at Chatham in 1816. Their opposition was overcome by those serious students of naval architecture who applauded Seppings' utilitarian purpose.[3] By 1828, when improvements had been made in Seppings' basic suggestion, notably in the addition of a counter, a former critic pronounced the roumd

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1. George Harvey, Observations on Sir Robert Seppings' Plan for the Circular Sterns of Ships of War (London, 1822), p. 19.

2. Seppings, Letter to Melville, pp. 3, 35, note. See also Ibid. pp. 4, 17, 20, note.

3. Dupin, Voyages, ii. ii. 162-63. Harvey, Observations, pp. 19, 25. Paixhans, Nouvelle Force, pp. 6-7. J. Marshall, Ships' Guns, pp. 28, 74.

stern universally accepted,[1] although as late as 1831, the Duke of Clarence was still reviling "that confounded round stern in ships."[2]

In addition to bows, sterns and trussed frames, Seppings provided stouter ships by a general strengthening of all members of the structure. Increased strength was also derived from the use of iron for many braces and clamps. By all these means, large ships capable of carrying increasingly heavy armaments were provided.[3]

Concerning armaments, one other alteration in ship construction deserves mention. This was the advent of the walled side. Up until the Napoleonic Wars, gunwales generally curved in toward the centre of the upper deck. This "tumble-home", as it was known, was considered necessary for the stability of the ship, but it made for a narrow deck. With the introduction of

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1. Napier, The avy, p. 89; for Napier's earlier criticisms see ibid. pp. 61-63. Robertson, pp. 53-54.

2. Add. MSS.41368, Martin memo. 5 Sept. 1831.

3. Robertson, p. 53. Sir Charles Stirling, A Letter with additional Observations on Professional Topics (Chertsey, 1827), pp. 72-78, 86-88.

more powerful artillery requiring increased room for recoil, wider decks became necessary. Thus, in the ships laid down toward the end of the war, tumble-home was reduced. There was little decrease in high, three-decked ships, but there was considerable reduction in two-decked vessels, while frigate walls were practically straight.[1]

By 1812, therefore, Britain had already taken considerable pains to prepare her ships for the heavier armaments necessary to equal French 18-pdrs. American success with their super frigates and 24-pdr. guns promised yet further increases in number and calibre of guns accompanied by similar increases in the dimensions of warships.

Britain's answer to the American 54-gun frigate had been Leander and Newcastle, each mounting 60 guns, together with the allocation of Congreve 24-pdrs., to the upper decks of ships of

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1. Dupin, Voyages, ii. ii. 160-61. Adm.7/712, "Armaments of United States Ships", fos. 39-41. Albion, pp. 393-94, attributes the advent of the walled side to the disappearance of oak hedgerows used for knees in the old construction.

the line. France soon followed with her own super frigates built on the British model, and, as discussed below, the adoption of the 30-pdr. After 1815 there developed a similar tendency for other classes of ship popular during the Napoleonic Wars to be superceded by the class above them. Once again it was the Americans who provided the impetus.[1]

During the War of 1812 they had laid down three ships of the line, the _Washington_, _Franklin_ and _Independence_. Nominally 74's, these ships in fact mounted upwards of 90 guns. Although none of the three saw action, and indeed two were completely unseaworthy, these vessels had considerable influence on European navies.[2]

To match these American ships, the French in 1819 were planning to replace the 82-gun ship that had supplanted the 74

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1. On the First French super frigates, see Dupin, _Voyages_, ii. ii. 95, 156-57; Paixhans, _Nouvelle Force_, p. 15; Bowles, _Pamphlets_, p. 65. On the increased dimensions of warships in general at this time, see Bartlett, _Sea Power_, pp. 30-31.

2. Chapelle, M.M. xviii. 300. Add. MSS. 41400, fos. 25, 40, undated secret memo. of Byam Martin.

in 1793, with 94's; Britain followed with a new class of second-rate, the 92-gun ship mounting long 24-pdrs. on its upper deck.[1] No attempt was made by either power to match the unsuccessful American first-rate, Pennsylvania, of four decks and 132 guns. But Britain and France laid down few first-rates mounting less than the 120 guns of Caledonian and Commerce de Marseille.[2]

The French were particularly vigorous in building the larger classes of the various rates. Of eight frigates building in 1820, six were 24-pdr. vessels on the lines of H.M.S. Leander, and a similar proportion of French ships of the line were first-rates.[3] The British, on the other hand, while not wholly ignoring the trend to build the largest classes, continued to devote much

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1. Paixhans, Nouvelle Force, p. 55. Bowles, Pamphlets, pp. 8, 30-35.

2. Bartlett, pp. 32-33. Bowles, pp. 33-34. Robertson, p. 50. According to Napier, The Navy, pp. 188-89, one first-rate of 116 guns and three of 104 were built for the Royal Navy between 1815 and 1850.

3. Bowles, pp. 65-69. Dupin, Voyages, ii. ii. 95, 156-57, 160-61, and A Tour Through the Naval and Military Establishments of Great Britain 1816-1820 (London, 1822), p. 61. Paixhans, Nouvelle Force, p. 15.

of their construction to smaller vessels. Thus more than half the twenty-six ships of the line launched between 1815 and 1825 were third-rates, and only six frigates of the twenty-eight built during the same years were fourth-rate super frigates.[1]

Britain's shipbuilding policy during these years ensured that many of her vessels were inferior in size to their foreign counterparts during the first half of the nineteenth century. The explanation for such a policy has been admirably summarized by C.J. Bartlett:

> Britain, more so than any other naval power, was unable to think exclusively of constructing a Navy able to meet her needs in any one set of circumstances, in any one region, or against any one power. Britain had to provide fleets to meet the diverse needs of the English Channel, the Atlantic, the Mediterranean, the Indian Ocean and even the Pacific. A local superiority was not enough. Ships were needed almost everywhere, and to make that possible - in peace when resources were not freely granted by Parliament; in war when Britain could never have too many ships at sea - small frigates, third-rate sail of the line, and ten-gun brigs were a great temptation to the Admiralty. Cheaper to build and maintain,

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1. Bartlett, p. 33. Bowles, pp. 30-35.

easier to man, and responsive to so many of the needs of the far-flung empire and trade, the existence of such ships is not to be explained solely by the dogged conservatism, the serene indifference to foreign precepts, the obstinant complacency of senile admirals as contemporary critics delighted to declare. What may appear indefensible at a tactical level may wear rather a different guise when viewed strategically.[1]

Thus British postwar ships, while greatly strengthened by Seppings' innovations, were nevertheless restricted in the armaments they could mount by virtue of their small size. And while the shortcomings of having built so small were not revealed to the Admiralty until 1826, as discussed below, the policy of building small ships had been settled upon immediately after the war. Once having decided to build the smaller rates of ship, another factor arose, related to those cited by Bartlett, to further encourage the proliferation of small ships. This was the desire to economize by limiting the varieties of ship and equipment through standardization.

By the same Order in Council of November 1816 that had

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1. Bartlett, p. 34.

instructed the Royal Marine Artillery to train naval gunners to a standard gunnery system, the Admiralty declared their intention to organize the Royal Navy "into one regular system."[1] Their purpose was to reduce not only the great variety of gunnery disciplines; they also wished to reduce the number of manning systems as well as the great variety of masting and rigging schemes that, in the words of one observer, "formed a source of perpetual expense and perplexity in our dockyards."[2] This could best be accomplished by standardizing ships themselves "as far as may be practicable."[3]

Since the days of Charles I, British warships had been grouped into six rates, with a seventh added under Charles II to include the many types of smaller craft. By 1816 there existed within these seven ratings forty-seven subclasses, all differing in masting, armament and rigging. This profusion of classes arose in part from the addition of foreign prizes to the Royal

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1. Adm.1/5228, Order in Council, 25 Nov. 1816.
2. Bowles, p. 6.
3. Adm.1/5228, Order in Council, 25 Nov. 1816.

Navy; but there was also a proliferation of classes within the navy itself, owing to the fact that old ships continued to serve with new vessels of nominally the same rate and class, but containing various modifications and innovations introduced with little system under the pressure of war.[1]

In 1816 the Admiralty planned to reduce these forty-seven sublcasses to a more manageable twenty, comprising three classes of first-rates, two of each rate from second to sixth, and six classes of seventh-rate. Each of the twenty subclasses was to have different rigging and armament, but within each class as much standardization as possible was to take place, thereby reducing masting and rigging schemes from forty-seven to twenty, and decreasing manning schemes from twenty-nine to thirteen or fourteen. It was realized that the great number of old ships comprising the navy, together with advances in armaments and architecture, would render perfect uniformity in this point impossible. Only at the expense of progress could complete

1. Ibid.

standardization be achieved; with the quickening pace in armaments development already perceptible in 1816, the Admiralty were not prepared to make this sacrifice.[1]

It was largely in masts, yards and rigging that the Admiralty believed uniformity desirable. They indicated no similar plans for standardizing armaments, apart from encouraging the standard gunnery system discussed in Chapter Two, and apart from ensuring that in future the real and nominal force of a vessel's armaments were identical.[2] But while the British plan to reform the navy did

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1. Ibid. See also Dupin, Voyages, ii. ii. 142-44.

2. Captures made during the War of 1812 revealed that both British and American frigates carried more guns than their rating indicated. Thus the American 44's in fact mounted 52 or 54 guns, and many British 38's, including Guerrière, mounted 50 guns. The 1816 Order in Council noted that "the majority of those (frigates) rated at 36 guns carry 44, and some of those rated at 32 carry 46 and 48, being more than others that are rated at 38 and 36." The reason given for this was the fact that in many cases carronades, which were not included in the rating of ships' armaments, had been issued to frigates, and then replaced with guns. Stressing the accidental origins of this apparent deception, the Order in Council admitted that it lay Britain open to charges of misrepresentation, and was thus "wholly unworthy of the character of the Royal Navy." For some of these charges of misrepresentation, see Dupin, Voyages, ii. ii. 90-93, 143, note.

not specify any systemization of armaments, a French observer concluded that a standard calibre of gun would be the logical accompaniment to the standardization of ships and rigging.

This observer was the French economist and statistician, Charles Dupin,[1] who arrived in England in 1816 to study the war machine that had defeated France. Born at Varzy in 1784, Dupin entered L'Ecole Polytechnique in 1801, and upon graduation was first employed as a marine engineer in setting up the naval arsenal at Anvers. After Trafalgar he spent four years establishing technical schools in the Ionian Isles, and on his return to Paris published a paper on the strengths of various woods in ship construction. In 1816, the year Britain commended the standardization of the Royal Navy, Dupin was granted permission to visit England. The result of his studies was the massive Voyages dans La Grande-Bretagne, published in Paris between 1820 and 1824, and still the most exhaustive study of British naval and military establishments in the early

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1. Nouvelle Biographie Général.

nineteenth century.[1]

It was Dupin who, having inspected the *Leander* on her return from Algiers, advised the French Inspector General of Marine Engineers that France set about building her own super frigates.[2] In believing that Britain would concentrate on building this class of frigate, Dupin was, of course, in error. He again erred in concluding that the adoption of Congreve's 24-pdr., together with Britain's intention of standardizing much of her naval equipment, indicated that the Royal Navy was to mount 24-pdrs. throughout the fleet. Nevertheless, on these assumptions, Dupin advocated in 1817 that France introduce the 24-pdr. as her standard calibre.[3]

But by 1821 Dupin was having serious second thoughts on

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1. The full title is *Voyages dans La Grande-Bretagne, entrepris relativement aux services publics de la Guerre, de la Marine, et des Ponts et Chaussées, en 1816, 1817, 1818, 1819, 1820* (Paris, 1820-24). It is in three quarto volumes, each in two parts. The first volume deals with the military, the third with the merchant marine. The second volume, by far the most important to this work, is concerned with the navy.

2. Dupin, *Voyages*, ii. ii. 95, 156-57.

3. *Ibid*. pp. 142-44, 156-57.

the matter. He predicted that the United States would soon raise its most common calibre from the 24-pdr. to the 32-pdr. gun. Indeed, secret memoranda of Byam Martin, Controller of the Navy, indicated that by 1817 the Americans were well on the way to this new armament, with the Franklin mounting eighty-six 32-pdrs., and the Independence fifty-six 32-pdrs. and thirty long 24-pdrs. Dupin believed the only way to avoid this apparently endless armaments spiral was for France to move directly to her largest practical calibre, the 36-pdr. He further suggested that every gun in the fleet be of this calibre.[1]

Such proposals for a standard or uniform calibre were age-old. Yet very little had been done in any navy toward attaining this desirable goal. Up until the sixteenth century, European land and sea artillery had been totally unclassed, and had consisted of whatever had come to hand. About the year 1544,

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1. Ibid. pp. 144-53. Paixhans, Nouvelle Force, pp. 71-74. For British awareness of American activity with 32-pdr. armaments, see Add. MSS. 41400, fos. 25, 40, secret Martin memo. of 1817.

Charles V of Spain decreed that all Spanish artillery consist of seven calibres. In 1550 France restricted her number of different calibres to six, soon followed by England's retention of seven large calibres with a host of lesser calibres.[1] Nevertheless, it was many years before any system of gun distribution was forthcoming. In 1815 Britain had more than twenty models of naval gun in seven different calibres.[2]

France also had seven calibres, but only fourteen different models. Dupin felt these were too many. He therefore advocated that the variety of calibres be replaced with one uniform calibre, the 36-pdr., and that the fourteen models be reduced in number to four. The ideal would have been to adopt one standard heavy gun for all naval purposes, but this was obviously impossible.

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1. Robertson, Naval Armament, pp. 72-90, 173-74. These were the 42-, 32-, 24-, 18-, 12-, 9- and 6-pdrs.

2. See Appendix A, Table I; W.O.44/498, Royal Arsenal Return of Sea Guns, 29 March 1813. It would perhaps be more accurate to say that there were only 6 calibres as at this time the 42-pdr. was used only in the form of carronades. Interest in 42-pdr. canon nevertheless continued.

To allow for the great variation in size and strength of ships, while retaining the maximum effect of calibre, demanded that there be several different weights of gun. Hence the four models advocated by Dupin.[1]

Henri-Joseph Paixhans, another Frenchman working independently of Dupin, had reached the same conclusions. An artillerist, and subsequently a proponent of the shell gun, Paixhans agreed that four models of different weights would permit practically every deck in the French Navy to carry 36-pdr. guns. In this way France would attain a uniform calibre of maximum effect, and at the same time greatly increase the broadside weight of metal in existing ships.[2]

Like Dupin, Paixhans had studied closely the increased weight of metal in British and American armaments immediately

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1. Dupin, Voyages, ii. ii. 144-53.

2. Paixhans, Nouvelle Force, pp. 55, 71-74. Paixhans estimated that the weight of metal of a French first-rate would be increased from 3159 pounds to 4600 pounds. Ibid. p. 74.

after the war. He noted, too, the effort to mount the largest possible guns in the greatest possible numbers, with the consequent strengthening and enlarging of ships. Indeed it was the great size and unwieldiness of these vessels that inspired him with the idea of providing small, maneuverable ships mounting a few destructive shell guns. Thus, unlike Dupin who advocated maximum uniform calibre for its own merit, Paixhans merely referred to it as the logical conclusion to an already obsolete armaments system.[1]

Paixhans also applauded the controversial Congreve 24-pdr. that so influenced the design of his own shell guns. Like Dupin, he interpreted Britain's introduction of this gun as an indication that the 24-pdr. was to become the Royal Navy's uniform calibre, and in this respect criticized its adoption on two counts. In the first place it was not the maximum calibre, which for the English was the 32- or possibly even the 42-pdr.

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1. Ibid. pp. 4-15, 74. On Paixhans' shell system, see below Chapter Four.

Secondly, as Congreve's gun was slightly smaller in the bore than regulation 24-pdrs. complete uniformity within the calibre was not attained.[1]

In fact, both Paixhans and Dupin erred in thinking that Britain in 1816 was planning to adopt "l'accroissement progressif de puissance et de simplification" of 24-pdr. uniform calibre.[2] Certainly the adoption of the Congreve 24-pdr. increased the broadside weight of metal of those ships receiving them, but there was to be none of the simplification associated with a standard or uniform calibre. The Royal Navy retained its complex, multi-calibred armaments. Thus, as shown in the partial table of ships' armaments on the following page, the two decked vessel that in 1811 mounted lower deck 32-pdrs. and upper deck 18-pdrs., replaced the latter after 1816 with Congreve 24-pdrs. This increased weight of metal by about two hundred pounds, half the increase that uniform 32-pdrs. would have

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1. Paixhans, Nouvelle Force, p. 71, note. See also Dupin, Voyages, ii. ii. 148.

2. Paixhans, Nouvelle Force, p. 15.

bestowed, but retained the disadvantage of mounting two calibres. Further study of the same table reveals that in other rates, three and even four calibres were mounted in the same ship.

Rate	Guns	A Batt.	B Batt.	C Batt.	Superstructure Guns	C'nades
1	120	32-32's	34-24's	34-18's	8-12's	12-32's
1	110	30-32's	32-24's	32-18's or 30-12's	6-12's	10 or 12-32's
1	104	28-32's	30-24's or 18's	30-12's	6-12's	12-32's
2	86	30-32's	32-24's C		8-12's	14-32's 2-68's
3	78	28-32's	30-24's C		6-12's*	12-32's 2-68's
	74	28-32's	28-24's C		6-12's*	12-32's
4	60	30-24's			2-24's	28-42's
5	46	28-18's			2- 9's	16-32's
6	24	16-32's			2- 6's	6-18's
7	18	16-32's			2- 6's	
	10	8-18's 2- 6's				

From Dupin, Voyages, II, ii. 144

C Congreve

* in some third-rates Congreve 24-pdrs. replaced the 12-pdrs.

This variety of calibres and gun models greatly complicated the arming of the Royal Navy. Each calibre, and indeed in some cases, each model of that calibre, required its own size of shot and charge, not to mention specially trained crews and specialized equipment for working the gun. The arming of even one ship posed serious problems in supply, stowage and combat efficiency. For example, the Caledonian of 120 guns, if armed as envisaged in the table referred to, mounted thirty-two 32-pdr. guns, thirty-four 24-pdrs., thirty-four 18-pdrs., eight 12-pdrs., and twelve 32-pdr. carronades.

To confuse matters further, there were thirteen different models of these four calibres in service. As a first-rate, it is probable that Caledonian mounted the heaviest model of each calibre, thus making it necessary to supply only four classes of gun and one class of carronade. Even at that, she had to carry probably five sizes of shot, and, as each weapon was provided with three sizes of powder charge, fifteen classes of cartridges with as many "reduces" as a particular situation or a particular gun might demand.[1]

Thus even in its simplest form, the arming of a large ship mounting several different calibres was a complicated business. Fighting such a ship was no less complicated. As an American observer wrote in 1857:

> All this variety of supply was to be distinguished and selected in the magazines and shot lockers - circulated with perfect exactness in the confusion and obscurity of the lower passages, to a particular hatchway, then up to the decks where was placed the gun for which each charge or shot was designed: and this was to be accomplished, not with the composure, deliberation, and attention that the nature of the operation itself demanded, but amid all the excitement and hot haste of battle.[2]

The efficiency to be derived from replacing multi-calibred armaments with uniform calibre, as advocated by Dupin and Paixhans, was obvious. Not only would the one class of shot and three classes of charge reduce the possibility of confusion and accident in battle; the whole business of manufacture, supply

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1. Robertson, Naval Armament, pp. 173-74.
2. J.A. Dahlgren, Shells and Shell Guns (Philadelphia, 1857), pp. 270-71.

and stowage would be greatly simplified.

In 1824, France adopted the principle of uniform calibre. The 36-pdr. was not, however, the calibre settled upon. As both Paixhans and Dupin had feared, the advantages in range and power of the 36-pdr. over the 30-pdr. were found to be more than offset by its tremendous weight and expense, with the result that the 30-pdr. was adopted. The adoption of the smaller calibre nevertheless conferred the advantages of uniform calibre on French ships, and greatly increased their broadside weight of metal. Moreover, as the 30-pdr. was a 33-pdr. by British measurement, France would continue to enjoy a small broadside superiority should the Royal Navy adopt the 32-pdr. as its uniform calibre.[1] The French proposals of 1824 made it likely that Britain would consider such a move. This likelihood was increased when, in 1825, France voted additional seamen and

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1. F.C.P. Dupin, Organisation de la Marine et des Colonies (Paris, 1834), i. 279-82. See also Dupin, Voyages, ii. ii. 153, and Paixhans, Nouvelle Force, pp. 13-14, for fears that the 36-pdr. would be too heavy.

and marine artillerists,[1] and when Britain feared that war, not only with France, but against a Franco-American alliance, was imminent.

British use of the Royal Navy to prevent European interference in the rebellion of Spain's Latin American colonies, had strained Anglo-French relations. In addition, America was seeking increased trade with the liberated colonies, largely at Britain's expense. Attacks on all commercial vessels in the Caribbean by Spanish privateers operating from Cuba brought matters to a head. British commercial losses had been sufficient to provoke criticism in the Commons, and the despatch of naval reinforcements to the area in 1822 and 1823. French and American commerce was losing as well, and the attention of the three powers turned to the pirate headquarters on Cuba.[2]

Considered by Mahan as the most strategic island in the

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1. Dupin, de la Marine, ii. 172-76.
2. Bartlett, Sea Power, pp. 68-73.

world after Ireland, the power controlling Cuba controlled the Caribbean. Prevailing winds necessitated most commerce with Central and South America sailing north of the island and within easy range of warships anchored there. Neither France, Britain or America wished Cuba to belong to either of the other two powers, but each was tempted to move against the pirates there. Britain feared the Americans and French would form an alliance to prevent her capturing Cuba. "Sooner or later," wrote Canning, "we shall probably have to contend with the combined maritime power of France and the United States."[1]

In 1825, Britain's naval artillery was less powerful than that of either country. For with America's having begun as early as 1817 to replace her 24-pdrs. with 32-pdrs., France's decision to move directly from the 18-pdr. common calibre to the 30-pdr. uniform calibre, would thus place the Royal Navy at a disadvantage if called upon to oppose those powers with its

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1. Ibid. p. 50.

24-pdr. common calibre. When it is recalled that even this weight of metal depended to a considerable extent on the light and erratic Congreve gun, it is not surprising that Britain once more reacted to foreign influence by again adopting more powerful armaments. The 18-pdr. had been adopted to match the French, the 24-pdr. to match the Americans; the 32-pdr. was adopted to match both the French and Americans.

Until 1813 the Royal Navy had possessed only one model of this calibre. Nine-feet six-inches in length and weighing 55 cwt., only the lower decks of ships of the line could comfortably support it. In July 1813, the Inspector of Artillery, Sir Thomas Blomefield, suggested that an eight-foot model of 47 cwt. be provided for use against the American 24-pdrs.[1]

Apart from six experimental guns cast in the same year, this model appears to have aroused little official interest until 1825. Alarmed at the increase of 32-pdrs. in the American armoury, the Admiralty in August and September of that year

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1. Adm.1/4021, Ordnance to Admiralty, 21 July 1813 and minute.

ordered six ships building at Bermuda and Jamaica, and the three-decked vessels Canada and Wolfe building on Lake Ontario, supplied with the Blomefield 32-pdrs.[1]

The fact that in 1825-26, French 30-pdrs., adopted in 1824, still existed largely on paper left Britain free to deploy her limited numbers of suitable heavy artillery against the Americans, with their heavy armaments in service.[2] Still small in numbers, the United States Navy had increased dramatically in power since 1814, boasting not only the experimental steam frigate Fulton, but also containing several superb sailing ships. This small navy alone could have been contained easily by the massive superiority of the Royal Navy, as h d been the case in 1814; but in alliance with France, the Americans could prove again to be

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1. Adm.1/4025, Ordnance to Admiralty, 9 Sept. 1825 and 17 April 1826 and minute. It will be recalled from Chapter One that 32-pdrs. domin ted American Lake armaments in 1813-14.

2. Having adopted uniform calibre in 1824, the French were very slow in producin the necessary new guns, a matter for complaint from Dupin (de la arine, i. 279-82), and probably the explanation for the fact that Robertson (Naval Armament, pp. 172-73) believed that France did not adopt uniform calibre until 1829.

skilful enemies.

In 1826 the American Minister in London found British hostility to his country almost as strong as it had been in 1812. In the same year the Admiralty began a serious reappraisal of American naval activity and construction.[1] Special reports from British naval officers and agents were unsettling. Admiral Sir Alexander Cochrane observed the North Carolina at Toulon and declared her the "finest ship of her class I ever saw."[2] Of her sister ship the Ohio, an anonymous observer reported "a more splendid ship I never saw."[3] Other such State Class ships as Vermont and New York also attracted attention. Nominally 74-gun ships, this class in fact carried between 102 and 106 guns, the equivalent of the smallest class of British first-rate. But whereas most British first-rates

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1. Bartlett, Sea Power, p. 70, note 3.
2. Adm.7/712, Admiral Sir Alexander Cochrane to Melville, 24 Dec. 1826. This volume of correspondence deals exclusively with American ships and armaments between 1826 and 1852, but is comprised largely of reports from officers and agents during the 1820's.
3. Ibid. fos. 39-41.

mounted 32-pdrs. on the lower deck, and 24-, 18- or even 12-pdrs. on the other two decks, State Class ships mounted 42-pdr. lower deck guns, and 32-pdrs. elsewhere. The second class of American ship of the line, containing such "74's" as Franklin and Independence, mounted upwards of 90 guns, mostly long 32-pdrs.[1]

Information had already reached the Cabinet to the effect that the largest British first-rates barely equaled the powerful broadsides of the American State-Class ship. Byam Martin, the Controller, was called upon by various members, including Lord Liverpool, to comment on the allegations. Although he sought to reassure the Covernment, Martin's private papers revealed that British first-rates were in fact less powerful than the American State-Class ships. The U.S.S. Ohio, mounting 102 guns, had a broadside weight of 1,794 pounds. Britain's largest first-rate, mounting 120 guns, threw only 1,568 pounds, while her smallest but most numerous ship of the line, the third-rate,

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1. Ibid. fo. 93. Add. MSS. 41400, fos. 25, 40, Martin memo., secret, 1817.

averaged only 928 pounds.[1]

Martin gave no figures comparing broadside strength of frigates, but if other reports on American frigates were accurate, their superiority over British counterparts must have been of the same m ssive proportions as obtained in the battleship class. For the thirteen frigates built or building in 1826, and rated as 44's, in fact mounted at least 60 guns. The Liberator (later Hudson) was pierced for 62 guns, and the Brandywine for 60. These fri ates, like the American ships of the line, had circular sterns and walled sides to permit carrying heavy 32-pdrs. The Bra dywine, strained and leaking from the weight of these guns h d reverted to long 24-pdrs. Nevertheless, it was planned to remount the 32-pdrs. in time of war. In the meantime the Americans were casting lighter experimental models of this

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1. dd. MSS. 41396, Martin me o. 25 July 1826, and Melville to Martin, 21 and 22 July 1826; 41397, M rtin to and from Clarence, 4-6 March 1828; 41403, Martin memo. un'ated fos. 53-56, 66. See B rtlett, Sea Po er, p. 33.

calibre.[1]

As a result of these revelations, Britain in 1826 undertook to bring her naval armaments into line with those of France and America. The problem immediately arose as to which system to adopt, French uniform calibre, or the American multi-calibre arrangement with 42-pdrs. on lower decks. The ordering of 32-pdrs. to America in 1825 indicated that the Admiralty were contemplating the former; the tremendous power and range of American 42-pdrs, on the other hand, gave rise to speculation as to whether the banked system should not be retained, but given power equal to the Americans. The solution to the problem lay in the armament weight the lower decks of British ships could bear. In August of 1826, the Admiralty ordered that four guns be cast and prepared for experiment, two 32-pdrs. of 60 and

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1. Adm.7/712, fos. 10-15, 23-24. It is probable that these American frigates, like those of France, were inspired by the British super frigates Leander and Newcastle built during the war to surpass the American super frigates. The Americans did not adopt uniform calibre until 1845, Dahlgren, Shell Guns, pp. 23-25.

64 cwt., and two 42-pdrs. of 80 and 85 cwt.[1]

Not since the late eighteenth century had the Royal Navy used the 42-pdr. to any extent. According to Sir Howard Douglas, a very few first-rates had mounted these massive guns on their lower decks before and during the Napoleonic Wars, although a Royal Arsenal return of all sea guns in service in 1813 listed only carronades of this calibre.[2] As it was largely the desire to match the American State-Class ship that inspired Admiralty activity in 1826, it was not surprising that interest in the 42-pdr. was rekindled in that year.

In August 1827 the four heavy guns ordered a year earlier commenced trials. The two 42-pdrs. were pronounced too heavy

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1. Ind.4993: 59-4, 30, 31 Aug. 1826. See also Adm.1/4025, Ordnance to Admiralty, 23 April 1827 and minute; 4027, Ordnance to Admiralty, 11 Aug. 1828.

2. Douglas, <u>Naval Gunnery</u>, 3rd ed., p. 222. Paixhans, <u>Nouvelle Force</u>, p. 58. W.O.44/498, Royal Arsenal Return of Sea Guns, 29 March 1813. 32-pdrs. began to replace 42-pdrs. on the lower decks of ships of the line in 1790. Adm.7/677, Admiralty Board to the Master General of the Ordnance, 22 May 1790.

for British ships of the line. In the light of Portuguese experience with 48-pdrs., and that of France with 36-pdrs., this was hardly surprising. Nevertheless, Sir Alexander Dickson, the recently appointed Deputy Adjutant General of Artillery, advised that if the 42-pdr. could be reduced in weight to 65 cwt., it would "possess great power and fully answer the object desired in again introducing 42-pdrs. into Naval Service."[1]

The Admiralty concluded that the 42-pdr. was not feasible, and that the 32-pdrs. of 64 cwt. tested with the 42-pdrs. become Britain's heaviest artillery. This decision in effect meant that Britain would follow the French model of uniform calibre of maximum practical effect. To this end experiments were carried out in 1826 and 1827 on two lighter 32-pdr. pieces proposed by Sir Alexander Dickson. His seven-foot six-inch model proved to be too light, and was rejected, but his five-foot six-inch gun

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1. Adm.1/4026, Dickson to Admiralty, 20 Aug. 1827.

of 25 cwt. was adopted.[1]

Thus, by 1827, Britain had rejected the 42-pdr., and had decided to adopt the four models of uniform calibre advocated by Paixhans and Dupin, and adopted by France in 1824. These four models were the existing regulation 32-pdr. of 56 cwt., the 47 cwt. model proposed by Blomefield in 1813 and sent to North America in 1825, and the 64 cwt. and 25 cwt. guns adopted in 1827. But with only sixty-six guns of 47 cwt. available for service in 1827, and even fewer of the 64 and 25 cwt. pieces in existense, it was to be many years before uniform calibre could be put into practice.[2]

One factor that served to delay the attainment of uniform calibre was the time required to produce sufficient 32-pdrs. to rearm the Royal Navy. The exact number necessary is not clear,

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1. Adm.1/4025, Ordnance to Admiralty, 9 Sept. 1825 and enclosures, 5 June 1826 and minute, 22 Nov. 1826; 4026, Croker memo. 22 Feb. 1827. Add. MSS. 41396, Martin to Melville, 31 Oct. 1826.

2. Adm.1/4025, Ordnance to Admiralty, 23 April 1827 and minute. For proposed new scheme of armaments see Adm.1/4026, Navy Office to Admiralty, 10 Oct. 1827.

but if returns of 1838 listing 27,924 pieces of all descriptions in the navy are any indication, it is safe to estimate that at least three-quarters of this number would be required.[1] Again, it is not clear what was the production capacity of the Ordnance Department with its various private contractors. Nevertheless some indication of the time required to supply the vast quantities of ordnance involved in a total re-armament can be derived from France's experience with the same problem.

France had adopted uniform calibre in 1824; yet as late as 1832 only 1,241 of the 3,000 carronades, and 1,493 of the 4,256 guns required had been produced.[2] Thus when the Duke of Wellington expressed concern in 1828 that France was attaining uniform calibre much more rapidly than was Britain, Sir George

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1. Adm.1/4034, Ordnance to Admiralty, 14 Nov. and 21 Dec. 1838 and enclosures. These enclosures refer only to Naval Guns on board commissioned ships and those in store at Woolwich, Chatham, Portsmouth and Devonport. In 1828 it was estimated that 1377 of the 47 cwt. models alone would be required for about fifty ships. Adm.1/4027, Ordnance to Admiralty, 11 Aug. 1828.

2. Dupin, de la Marine, i. 279-82.

Cockburn, First Sea Lord, could assure him that of the more than 4,000 guns required by the French Navy, only 380 were promised for 1828.[1] And while it is impossible to ascertain what portion of France's production capacity these figures represented, it is clear that the time required to provide the necessary guns delayed the advent of uniform calibre.

A second factor also helped to delay the attainment of uniform calibre. This was the need to alter many of the ships in the Royal Navy so that they could support the increased weights of the new armaments. It was at this point that Britain found cause to regret having built her ships so small after 1815. It will be recalled that more than half the twenty-six ships of line built between 1815 and 1825 had been second- and third-rates, and that only six of the twenty-eight frigates built during the same period were super frigates. The Admiralty thus discovered in 1826 that their eight super frigates built or building, compared with America's fourteen and France's twenty-nine, and

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1. W.N.D. iv. 361-69, 685-86. Bartlett, Sea Power, p. 38.

that not one British ship of the line could support the armament weight of the American State-Class ship.[1]

During the summer of 1826, therefore, when the Admiralty had determined to cast heavy 32- and 42-pdr. guns for lower decks, steps were taken to provide ships stout enough to support the immense weights involved. Ten first-rates were ordered to be built or reconstructed, and ten fourth-rate super frigates provided by building or by cutting down 74-gun ships.[2] During the autumn of 1826, and with the same purpose of preparing the navy for heavier armaments, another fourteen ships of the line were selected for doubling.[3] "Doubling" referred to the expedient of

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1. See above.

2. Add. MSS. 41396, Melville to Martin, 21 and 22 July 1826; Martin memo. 25 July 1826. Bartlett, p. 33.

3. Add. MSS. 41396, Martin to Sir George Cockburn 19 Oct. 1826, to Melville, 31 Oct. 1826 and delivered to Cockburn 1 Nov. 1826, to dockyard commissioners, 7 and 10 Nov. 1826, to Admiralty, 4 Dec. 1826. The ships ordered for doubling were: _Asia_, _Ganges_, _Monarch_, _Goliath_, _Thunderer_, _Neptune_, _Nelson_, _Saint George_, _Caledonian_, _Trafalgar_, _London_, _Queen Charlotte_, _Royal George_, _Waterloo_.

lapping over the existing external walls of a ship with additional planking; so far as these fourteen ships were concerned, this was to consist of "an increase of one foot [in breadth] to extend upwards from the seat of water ... and then to break gradually into the form of the ship, so that the upper deck will have only its present breadth."[1] This increased breadth was to provide the water displacement and stability necessary to permit mounting 32-pdr. guns.

Other alterations were necessary if these ships of the line were to bear such heavy armaments. Deck beams and planking had to be heavier; with the exception of the teak decked Asia and Ganges, the deck planking of the other twelve ships was increased from three inches in thickness to four inches. The great size of the new 32-pdrs. also necessitated alterations in gunports. So high did these guns stand on their carriages, that most ports were too low to permit running out, let alone elevating the weapon to fire at extreme range or at elevated coastal batteries.

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1. Add. MSS. 41396, Martin to A. Seppings, 1 Sept. 1826.

For three years the dockyards struggled with the problems of altering ports and decks to adequate dimensions; so great was the work involved in grooming ships of the line for heavier armaments, that the 32-pdr. became distinctly unpopular in the dockyards.[1]

These alterations occurred at an awkward moment in the history of British naval architecture. It had become clear in 1826 that Britain had built her ships too small in comparison with those of other nations, and that the necessity for doubling resulted from the "invincible unwillingness" of the Admiralty to permit designers to give sufficient breadth and stability to their ships.[2] Trials held in 1827 and 1828 between ships of various designers, were closely followed by the public who were outraged at the poor showing of those designed by the Admiralty. The Navy

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1. Adm.1/4026, Ordnance to Admiralty, 19 March 1827; 4027, 25 April and 4 July 1828; 4028, 13 May 1829 and enclosure. W.O. 44/499, Admiralty to Ordnance, 17 Feb. 1829. Add. MSS. 41396, Martin to Melville, 21 Aug., 31 Oct. and 7 Dec. 1826.

2. Bowles, <u>Pamphlets</u>, p. 40.

Board, the Admiralty and the Surveyor of the Navy, Sir Robert Seppings, were alike subjected to fierce criticism. In 1829, the School for the Improvement of Naval Architecture, opened in 1811, closed its doors.[1]

In this same year, and amid continuing heated controversy, the first-rate _Caledonian_ was brought forward. She had just completed the alterations ordered in 1826, and was in the process of receiving her armaments. To the horror of Byam Martin, the Controller, _Caledonian_'s 32-pdrs. weighed sixteen tons more than had been anticipated, leaving her midship ports a mere two inches above the water. Martin begged Cockburn not to "start the ship upon trial under so manifest a disadvantage." Such a course, he warned the First Sea Lord, would "subject us to public remark which is not pleasant."[2]

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1. Bartlett, _Sea Power_, pp. 34-38. Bowles, _Pamphlets_, pp.20-27, 33-46. Briggs, _Naval Administration_, pp. 8-10. _Napier, The Navy_, pp. 56, 64-66. Stirling, _Professional Topics_, pp. 72-78, 86-88. A brief history of the School of Naval Architecture is to be found in P.P.(1833), xxiv. 315-30.

2. Add. MSS. 41398, Martin to Cockburn, 6 Aug. 1829.

Martin also feared that another class of ship would not wear its new armament well. This was the Barham class frigate provided by razeeing, or cutting down, 74-gun ships. Despite Martin's protests, the Admiralty persevered in its policy of providing super frigates by this method, and of mounting long 32-pdrs. on the maindeck and eight-foot 32-pdrs. on the weather deck and forecastle. Not until 1831 were fifth-rate frigates similarly armed.[1]

Martin's intense dislike of increased armament weight in ships designed for lighter weights, revealed in 1815 when the Congreve 24-pdr. was adopted for upper decks, and revealed again in 1829 when 32-pdrs. were beginning to appear, mysteriously disappeared in 1830. In that year he recommended that 32-pdrs. be used everywhere in ships of the line, and that frigates unable to carry these guns be doubled, cut down to corvettes, or turned

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1. Adm.1/4025, Ordnance to Admiralty, 5 June 1826 and minute; 3473, Admiralty to Navy Board, 10 Jan. 1831. See also Ind.4993: 59-4, 13 Dec. 1826; 5001: 59-4, 2 July, 22 and 29 Aug., 17 and 29 Sept. 1827.

into troop ships. Melville approved most of these recommendations, but before they could be put into effect, Sir James Graham replaced him as First Lord of the Admiralty.[1]

Graham was in agreement with Melville and Martin on the desirability of uniform calibre. By Admiralty Order of 10 January 1831, all first-rates were to mount an exclusively 32-pdr. armament. The four models approved in 1827 were to be used. And although Graham disapproved of "doubling" or "filling out", he agreed that 84-gun ships should be "enlarged generally or have an increase of breadth sufficient to attain the object required."[2]

Again, as Martin and others had suggested, the inferior third-rate ships of the line and fifth-rate frigates that Britain had concentrated on building since 1815, came in for close scrutiny. No further third-rates were to be laid down, and those building were to be completed as speedily as possible. All work on fifth-rate frigates was suspended to determine

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1. Add. MSS. 41368, Martin's State of the Navy proposals of 1830, fos. 264-66.

2. Add. MSS. 41368, Admiralty Order of 10 Jan. 1831. See also Adm.1/3473, Admiralty to Navy Board, 10 Jan. 1831.

those that could be strengthened to mount 32-pdrs., and those better suited for corvettes or troop ships.[1]

Britain's navy in 1830 was thus taking on a considerably different shape from the one the Admiralty had planned in 1816. The Order in Council of November of that year had anticipated a standardization in classes of ships and the continuation of multi-calibred armaments. What in fact came about was a standardization of armaments by the adoption of the 32-pdr. uniform calibre, that in turn rendered the existing classes of ship too small. To support the increased weight of the new armaments, existing ships had to be strengthened and enlarged, and proposed ships given greater dimensions. In this way the wooden sailing ship of the line achieved its greatest magnitude in size, in power, and in efficiency.

But the orders of 1830 were never completely carried out, both in regard to the introduction of uniform calibre, and in the provision of a new generation of ship of the line. Thus

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1. Ibid.

while in 1833 Sir Augustus Frazer of The Royal Laboratory noted a shortage of 32-pdr. cartridges, owing to "the almost total exclusion in our armaments of any other calibre for large vessels", [1] the Ordnance Department in 1835 still adverted to the fact that,

> ... although the ships of His Majesty's Navy are classed, it is not found that any two ships of any one class (except that of ten guns) are armed with ordnance of the same nature, which occasions a considerable variation as to the powder and ammunition allowed ...[2]

In fact uniform calibre was attained slowly and imperfectly. By 1840 there were still a great number of 18- and 24-pdrs. in the fleet; and although the 32-pdr. was then by far the most common calibre in service, there were not four models of this calibre, as had been planned in 1827, but nearly fourteen. This abundance of models stemmed from the fact that, as discussed in Chapter Five, the Admiralty resorted to the expedient of boring up lesser calibres to 32-pdrs. This step had the advantages of

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1. Supply 5/31, Sir Augustus Frazer to Captain Henry Duncan, 25 Nov. 1833.
2. Adm.1/4031, Ordnance to Admiralty, 2 March, 1835.

providing the vast numbers of necessary guns more quickly, as well as attaining 32-pdr. broadsides with existing artillery, thereby saving money through not having to provide new weapons or enlarged ships. But the overriding consideration behind the Admiralty's decision to compromise on uniform calibre and enlarged warships, was the fact that new weapons introduced by the French, and adopted by the Admiralty in small quantities in 1830, threatened the sailing ship of the line and its solid shot artillery with extinction. This new weapon was the shell gun.

Chapter Four

THE EIGHTEEN TWENTIES: NOUVELLE FORCE MARITIME

The adoption of uniform calibre to increase the power and efficiency of solid shot armaments coincided with the introduction of shells into naval service. Paixhans in France had observed the increasingly heavy guns in the navies of the world, and the increasingly heavy ships necessary to carry them. He believed that one shell exploding at the waterline of such a ship would sink it. He further believed that if France mounted shell guns in her sailing fleet and in war steamers, she could bring about a revolution in naval architecture that would force Britain to abandon the large sailing navy that was the mainstay of her power to compete on equal terms with French steamers. In 1821 Paixhans published his Nouvelle Force Maritime. By 1829 shell guns mounted on war steamers had demonstrated their value for warlike purposes, and the Melville administration was preparing to introduce both into the Royal Navy. During the eighteen twenties the problems and dangers that had plagued horizontal shell-fire for two centuries were largely overcome.

Shells were first used as projectiles in the mortar. With its high trajectory and notorious inaccuracy, this weapon was best suited for the bombardment of large towns and forts under siege, and was used for this purpose in land warfare by the middle of the sixteenth century.[1]

Owing to the risks of fire on shipboard, however, shells were not used by sea services until a considerably later date, and then only in small, specially designed craft called bomb or mortar vessels. Five such vessels took part in the French bombardments of Algiers in 1680 and 1688, and in 1689 a French "Ordonnance" created two companies of bombardiers to operate the

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1. J.P. Baxter, The Introduction of the Ironclad Warship (Cambridge, Mass., 1933), pp. 18-19. Garbett, Naval Gunnery, p. 233. Hime, Origin of Artillery, pp. 194-97. Majendie, Smooth-bore Ordnance, p. 21. Paixhans, Nouvelle Force, pp. 86-88.

mortars of this new flotilla. In the same year, English mortar vessels set on fire and wholly disabled a French ship at Bantry Bay. Five years later, in 1694, the English and French each lost a vessel to mortar shell fire at Havre, while an English squadron of bomb vessels levelled 1400 houses at Dieppe. Sir John Leake repeatedly demonstrated the effectiveness of such shell fire in reducing castles and towns along Spain's east coast during the first years of the eighteenth century.[1]

As mortar vessels were slow, clumsy sailors unable to keep up with ships of the line, Lieutenant Colonel Browne, Master Gunner of England, proposed shooting grenades and fire-shot from cannon so that all ships might have shell-firing capability. A council of officers studying Browne's proposal on board H.M.S. Triumph in July of 1701, concluded that forty or fifty of each projectile be issued to great ships in time of war, "provided they can be well secured from taking fire and doing

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1. Baxter, p. 18. Dupin, Voyages, ii. ii. 80-81. Paixhans, Nouvelle Force, pp. 87-90. N.R.S. Leake, ii. 103, 131, 257.

mischief in our own ships."[1] This same cautionary spirit that had moved William Monson to admonish Elizabethan seamen to prepare such contrivances on shore, "or otherwise into sea far from the ship",[2] apparently still gripped the Admiralty; for there is no evidence that the Triumph resolution was officially adopted.

Browne's plan was significant in that it not only proposed introducing shells on shipboard, but also because it was one of the earliest attempts to impart the superior accuracy and penetration of high velocity gunfire to these projectiles. Fired from mortars or howitzers (a light mortar designed to serve as a field piece) at low velocities, shells described a parabolic trajectory that resulted in poor accuracy and no penetration. Nevertheless, several seventeenth century artillerists had attempted to attain both precision and penetration with shells by firing them from howitzers laid almost horizontally. As early as 1602, Renaud-Ville, an engineer in the French service, proved

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1. Baxter, p. 19. N.R.S. Rooke, p. 113.
2. N.R.S. Monson, iv. 44, note.

unsuccessful in such atte pts at the siege of Ostend. In 1689, however, the Master Gunner of England, Richard Leake, mounted two of his "cushie pieces" aboard the mortar vessel _Firedrake_, and by the end of the century, howitzers designed to fire shells nearly horizontally were available for use on these vessels.[1]

Not until the middle of the eighteenth century, almost fifty years after the _Triumph_ resolution, were attempts made to fire shells horizontally from high velocity guns as opposed to howitzers. In 1749, tests held by M. Leduc at Strasbourg, and M. de Valiere at Berg-op-Zoom, were unsuccessful, as were secret French tests from a naval 24-pdr. in 1760.[2] In June of the same year, the English demonstrated a comparable lack of achievement at Acton Common. Shells were fired from 12- and 24-pdr. naval guns, "but as the shells were found frequently to burst in the guns, it was thought too hazzardous to introduce them on board ships of war." Similar disappointments rewarded Royal Artillery

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1. J.A. Dahlgren, _Shells and Shell Guns_, pp. 4-5. Baxter, pp. 18-19. Robertson, pp. 160-61. N.R.S. _Leake_, i. 10-12, 22-23.

2. Paixhans, _Nouvelle Force_, p. 91.

trials in Canada during 1776.[1]

These failures stemmed from two great defects in shell construction. In the first place, the poor iron casting techniques of the day could not be relied upon to provide shells strong enough to withstand a cannon's blast, yet fragile enough to be shattered by their bursting charges. The second defect in shells, and one persisting until well into the nineteenth century, concerned the fuze that ignited the bursting charge. As the fuze projected from the shell, not only was accuracy impaired, but the shell had to be placed in the gun with its fuze facing either the breech or the muzzle. In the first instance, the blast frequently drove the fuze into the shell, bursting it prematurely; if facing the muzzle, the fuze often failed to ignite, consequently the shell could not explode. If, despite all these hazards, the projectile left the gun intact and with its fuze activated, there remained the possibility that

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1. Robertson, Naval Armament, p. 163, note. W.O.55/1823, "A Treatise on Artillery", 1780(?), fo. 6.

the fuze would not burn for the proper interval of time, causing the shell to explode before it reached the target, or to be shattered by the target before it could explode. Technology was not yet sufficiently advanced to provide for all the delicate calculations required if shells were to be fired from guns successfully.[1]

In 1779, however, at the siege of Gibraltar, Captain Mercier of the 35th Regiment did successfully fire 5.5-inch mortar shells from long 24-pdr. guns into the Spanish ranks. This first recorded firing of shells from cannon under fire impressed the English not at all. They showed a like indifference to reports of successful French testing in 1778, 1780 and 1784, and made no immediate effort to adopt the deadly spherical case shot demonstrated by Lieutenant Henry Shrapnell a few

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1. On the difficulties presented by fuzes, see Douglas, 3rd. ed., pp. 314-22; Hime, Origin of Artillery, pp. 212-15; Majendie, Smooth-bore Ordnance, pp. 232-40; Paixhans, Nouvelle Force, pp. 137, note, 193-95, 212-13, 245-54; John Scoffern, Projectile Weapons of War (3rd ed., London, 1858), pp. 144-50. See below.

years later.[1]

This surprising attitude was undoubtedly in part owing to the fact that in 1779, the year that Captain Mercier demonstrated his resourcefulness at Gibraltar, the first "smashers and lesser carronades for solid, ship, shell and carcass shot" were used against French ships.[2] Five years earlier, General Robert Melville had proposed a short 8-inch gun weighing only 31 cwt., but capable of firing 68-pdr. shot. Described as a gun on the outside and a mortar on the inside, "Smashers" and carronades offered many advantages. A carronade was about half the weight of a gun of the same calibre, used much smaller powder charges, and required only a few men to operate it. These agreeable properties were shared by all "lesser carronades", and the 32-

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1. Baxter, p. 19. Clowes, v. 277, note. Robertson, p.163, note. T.H. McGuffie, The Siege of Gibraltar (London 1965), pp. 77-78. McGuffie states that of 200,600 rounds fired between 1779 and 1783, 129,000 were shells, but that they were a makeshift and "suitable only for the special conditions of Gibraltar."

2. Robertson, p. 127. For greater detail on the carronade, see Ibid. Chapter Five, and above Chapter One.

and 24-pdrs. became highly favoured for the defense of merchantmen, and for the quarter decks and forecastles of warships.

The controversy aroused in naval circles over the carronade's introduction has been discussed in Chapter One. Strangely enough, the new weapon's shell-firing capability played no part in this controversy, and the carronade was judged solely on its performance with regulation solid shot. Thus while General Melville recommended issuing carcass and common shells for carronades during the American revolution, and several authors agree that this policy was followed to a considerable extent throughout the long French wars, there is little evidence that common shells were issued to the Royal Navy in any great numbers.[1]

Indeed, according to an incomplete Royal Laboratory report of 1811, no common shells were officially issued to any British ships save bomb vessels between the years 1783 and 1811, and carcass shells were the only "combustibles" considered

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1. Baxter, p. 20, Dahlgren, Shell Guns, pp. 10-13. Dupin, Voyages, ii. ii. 80-81, 121-22. Paixhans, Nouvelle Force, p. 97. John Scoffern, Projectile Weapons, p. 56, and New Resources of Warfare (London, 1859), pp. 6-8

sufficiently safe to be carried in large ships.[1] As late as 1820, both Ordnance and Admiralty expressed concern that the carronade had been assessed only in terms of firing solid shot, whereas its performance with hollow shot and shell had not been tested.[2] One of the original purposes of the carronade had been lost sight of, probably owing to undiminished fear of the dangers of combustibles aboard ship.[3]

The outbreak of the French wars in 1792 gave a great impetus to ordnance experiments. Especially in France, where the carronade was not adopted until near the turn of the century, did artillerists concern themselves with horizontal shell fire. From 1791 to 1799, Lieutenant General Count Andréossy experimented so successfully with ricochet shell fire from naval guns, that he recommended to Bonaparte that it

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1. W.O.44/498, Royal Laboratory Report of Sir William Congreve, 26 Oct. 1811. Carcass and shrapnel were occasionally fired from carronades in action. Clowes, v. 69, 123, 214, 222, 261, 264, 175-77, 384, 516.

2. Adm.1/4024, Ordnance to Admiralty, 7 May 1820, enclosure and minute.

3. Robertson, p. 139. Dahlgren, Shell Guns, pp. 8-13.

replace hot shot in sea service.[1]

Subsequent testing of ricochet fire at Cherbourg in 1794, and at Toulon in 1795, on the other hand, convinced a special committee that shells on shipboard remained a grave danger to friend as well as foe. Their recommendation to postpone further experiments until peace permitted exhaustive testing was not, however, adopted. For in April 1797, shells fired from 24-pdr. guns burst upon a hulk at Cherbourg with such devastating effect, that observers believed no ship of the line could surive fifteen minutes with similar damage to her waterline. The committee consequently reversed its 1795 decision, and in January of 1798 recommended the introduction of shells into sea service.[2]

The French Navy sustained more damage from its shells than did the enemy. At the Battle of Aboukir Bay, the destruction of their flagship <u>L'Orient</u> was hastened when her own incendiaries caught fire and exploded. A similar disaster

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1. Baxter, p. 20.

2. <u>Ibid</u>. pp. 20-21. Paixhans, <u>Nouvelle Force</u>, pp. 95-100, 124-26.

terminated an engagement off Gavre, and reports of recurring accidents with shells aboard French ships, spread panic through that fleet and encouraged other powers to continue restricting their issue of shells to bomb vessels.[1]

It is probable the French withdrew shells from large ships shortly before Trafalgar. They nevertheless studied other uses for shells, and continued the attempt to solve the problems connected with horizontal shell-fire. Thus Bonaparte ordered on June 17, 1803, that each pinnace in the Boulogne flotilla mount an "obusier", and the following year had long howitzers cast for the protection of Toulon and other French ports. Ten years of continuous experimenting with shells fired from guns, although rewarded in 1811 by bursting only 29 out of 169 shells

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1. Baxter, p. 21. Garbett, pp. 16-17. Jurien de la Gravière, Guerres Maritimes sous la République et l'Empire (Paris, 1883), ii. 94-96. According to Douglas, 3rd ed., p. 322, four or five ships of the line and six frigates or lesser vessels were put out of action through the explosion of their own incendiaries.

effectively on target, convinced French artillerists that they were on the right track, and in that year Bonaparte approved plans to forge an experimental 8-inch shell gun at Douai. Owing to the course of the war, this gun was never tested.[1]

Britain's experience with shells during these war years, while not extensive, paralleled that of France. Extreme caution alone prevented the Royal Navy from duplicating the disasterous French move to introduce shells. Thus the same mistaken hope of having solved the problems of horizontal shell fire, the same hope that had led France in 1798 to introduce shells into service, had encouraged Admiralty experiments as early as 1796. Rather than marvel at the destructive properties of a few successful shells, however, the Admiralty concluded that this ammunition was still too dangerous to serve in large ships, and continued to provide it only for the mortars and howitzers aboard mortar vessels. Tested aboard one such vessel, the _Vesuvius_, at Stoke

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1. Baxter, pp. 21-22. Garbett, pp. 16-17. Paixhans, _Nouvelle Force_, pp. 98-106, 140-44. Robertson, p. 165.

Bay in May of 1797, shells were stored in the Tower of London for issue to these ships, and for unspecified "particular services."[1]

The Admiralty's refusal to permit shells aboard ship notwithstanding, the 1802 edition of Adye's semi-official Bombardier and Pocket Gunner listed the shell diameters required for each calibre of sea service gun. As few of these projectiles were in fact produced, Adye suggested that any shell could be fired from a gun of smaller calibre, providing the gun elevated sufficiently to balance the shell on its muzzle. Such advice, coupled with the solemn instruction to reject those shells having surface cavities and abrasions greater than three-quarters of an inch in depth, indicated that a high order of accuracy was not expected.[2]

Indeed, Royal Artillery experiments in 1803 once more

1.Add. MSS. 37878, R.H. Crew to W. Windham, 28 Dec. 1799. Douglas, 1st ed., pp. 297-99. Paixhans, Nouvelle Force, p. 97.

2. R.W. Adye, Bombardier and Pocket Gunner (2nd ed., London, 1802), pp. 251-22.

affirmed the unreliability of shells and spherical case shot (shrapnel). "The flight of the shell has no velocity," the Deputy Adjutant General of Artillery cautioned an artillery captain, "and burst them as we will, the shot does not penetrate the target at five or six hundred yards; when the enemy comes nearer, let me advise you to limber up, and leave the rest to the cavalry."[1]

By 1803, therefore, the Admiralty's fear that shells were neither safe or reliable had been confirmed, and between that year and 1811, little attention was given to horizontal shell-fire. In 1811, the year France had climaxed ten years of continuous testing by ordering experimental 8-inch shell guns, the Admiralty did consider a "fireball" claimed to have been invented by a Mr. Fane. This fireball, consisting of solid shot coated with combustible materials, was in fact an old type of ammunition, as Sir William Congreve pointed out. In any

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1. W.O.55/1148, J. Macleod, Deputy Adjutant General of Artillery, to Captain Bloomfield, 22 Oct. 1803.

case, the Admiralty rejected it on the grounds that, if adopted, it would "endanger the British Fleet more than the French."[1]

In July 1811, and again in January 1813, Lieutenant John Harvey Stevens of the Royal Marine Artillery recommended a more widespread use of shells in the Royal Navy. While in charge of ordnance aboard the bomb vessel Fearless in 1810, Stevens had substituted 68-pdr. carronades for the regular 8-inch mortars, and had achieved startling results. Trials held at Sutton Heath confirmed the fact that 68-pdr. carronades used as mortars held a range superiority of 1500 yards over brass 8-inch mortars, although inferior by almost three-quarters of a mile to

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1. Adm.1/4020, Ordnance to Admiralty, 28 Aug. 1811 and enclosures, Admiral Moorson to Admiralty, 19 Oct. 1811 and enclosures. See W.O.44/498, packet entitled "Inventions 1811 - Mr. Fane's Fireballs". Sir William Congreve took advantage of the opportunity to express the Royal Laboratory's opinion on incendiaries for sea service in general, and concluded "that round carcasses are the only combustibles which should be used on Ships of War which are not fitted for firing Red Hot Shot." Adm.1/4020, Ordnance to Admiralty, 28 Oct. 1811, enclosing Congreve to Ordnance, 26 Oct. 1811.

the more common 10.5- and 13-inch sea mortars. Stevens' suggestion that the carronade would serve well either as a mortar or a howitzer on gunboats and other small vessels was not, however, adopted.[1]

In 1814, another John Stevens, an American working with his two sons in Hoboken, New Jersey, developed an elongated shell. Designed for service with Major George Bomford's "Columbiad", a chambered piece capable of firing both solid shot and shells, the American Chief of Ordnance believed elongated shells the answer to many of the objections against the use of shells on shipboard.[2] The effect of this 9-inch percussion shell against a target representing the side of a ship led the Stevenses to predict a revolution in naval architecture. Although the

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1. Adm.1/4020, Ordnance to Admiralty, 12 July 1811, enclosing committee report of 3 July 1811. Baxter, p. 22, note. For a brief summary of Stevens's early services, see Adm.1/3557, Sir Richard Williams to Admiralty, 27 Aug. 1827, enclosing Stevens to Williams of the same date, and Williams to Admiralty, 15 Sept. 1827, enclosure.

2. Baxter, p. 23.

Americans ordered Bomford shells for both Army and Navy, the coming of peace in 1815 ended official interest in the new armament, and the Stevenses' proposals for iron-plated gun-boats, floating batteries and war steamers mounting shell guns, went unheeded.[1]

The Stevenses' view that shell fire would revolutionize naval architecture was shared by a brilliant French artillerist, Colonel Henri-Joseph Paixhans. Born at Metz in 1783, Paixhans graduated from L'Ecole Polytechnique into Bonaparte's Artillery. In 1809 he commenced working on horizontal shell fire, and ten years later submitted to the Minister of Marine and Colonies his design for the new French Navy. In 1821, and again in 1822, Paixhans published his ideas in a volume appropriated entitled

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1. Ibid. pp. 8-9, 22-23. Dupin, Voyages, ii. ii. 134-35. Paixhans, Nouvelle Force, p. 137, note.

Nouvelle Force Maritime.[1]

Expressly disclaiming the title of inventor, Paixhans cited past examples of the destructive powers of shell fire,[2] and argued the need for such capabilities in existing ships. A ship of the line, he asserted, was practically invulnerable to solid shot of the highest calibre. At Trafalgar, despite an

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1. Nouvelle Biographie Général (Paris, 1856). The full title is: Nouvelle force maritime, et application de cette force à quelques parties du service de l'armée de terre; ou Essai sur l'état actual des moyens de la force maritime; Sur une espèce nouvelle d'artillerie de mer, qui détruirait promptment les vaisseaux de haut-bord; Sur la construction des navires à voile et à vapeur, de grandeur modérée, qui, armés de cette artillerie, donneraient une marine moins couteuse et plus puissante que celles existantes; Et sur la force que le système de bouches-à-feu proposé offrirait à terre, pour les batteries de siège, de places, de côtes et de campagne. (Paris, 1822. 4to. xv, 458 pp., with 7 plates.) Pages 1-74 are a revision of his Nouvelle Force Maritime, ou exposé des moyens d'annuler la force des marines actuelles de haut-bord, et de donner à des navires très-petits, assez de puissance pour détruire les plus grands vaisseaux de guerre. (Paris, 1821). Citations in the present work are from the edition of 1822. Much of my information in the following paragraphs on the earliest uses of shells is based on Paixhans, as is that in Baxter. Neither source is satisfactory for British experiments in the 1820's.

2. Paixhans, Nouvelle Force, pp. vii, 86-110.

immense expenditure of shot, not one ship had been sunk in action, and at Algiers in 1816, the British ship Impregnable had sustained more than fifty direct hits, near or below the water-line, without in any way endangering her. Had Impregnable been hit by shells rather than shot, as had been the hulks fired upon at Cherbourg in 1797, and at Walcheren in 1811, Paixhans believed she would have been sent to the bottom.[1]

The first nation to introduce shell guns into sea service would therefore, in his opinion, hold other fleets at a tremendous disadvantage. Improved metallurgy and Paixhans' own experiments with shells, convinced him that France was in a position to assume this advantage by introducing his proposed new guns into her existing fleet. By this move, 500 British ships and 150 French ships would become obsolete, and the opportunity arise for France to commence a steam navy on an equal footing with Britain. For it was upon a fleet of small war steamers mounting shell guns that Paixhans based his prediction of a naval supremacy that would render France "tout à coupe,

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1. Ibid. p. 77.

maîtresse de mers."[1]

Paixhans believed the advantages of such a fleet to France would be twofold, one temporary and one permanent.[2] The steamer, small, fast and nimble, would present a difficult target to ships of the line, while itself capable of bringing shell guns to bear upon the cumbersome and vulnerable adversary, independent of the wind. England's vast fleet, soon coming to fear "le plus petit navire", would be scrapped in order to meet the French on their terms. This would be a temporary advantage; for Paixhans realized that Britain would ultimately build larger fleets of war steamers than France.

But the very nature of steam warfare, Paixhans asserted, guaranteed France certain permament advantages from the impending naval revolution. With small ships costing less to build and maintain, France's timber supplies would be sufficient for the purpose, and thus end her dependence on foreign countries

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1. Ibid. p. 127. For Paixhans' references to steam, see v-xiv, 285-348.

2. The information for this and the next two paragraphs is to be found in Ibid. pp. 346-48. See also Baxter, p. 25.

for materials. Of greater significance to France, however, was the fact that the new fleet would require fewer seamen, and that the quality of seamanship need not be high.

Paixhans realized that England's naval strength lay to a considerable degree in her large seafaring population skilled in the working of sailing vessels. France despite her larger population, had comparatively few men trained to the sea. Steam warfare would convert this liability into an advantage; for with the emphasis on the more soldierly qualities that Paixhans associated with the working of steamers, a nation's seapower would become proportional to its total population, rather than to that part of it that was seafaring. Twenty thousand British sailors would no longer dictate the law to the world.

Paixhans' whole system, however, centered upon the introduction of his as yet non-existent shell gun. On 28 May 1821, a committee of high ranking naval and artillery officers, having studied Paixhans' proposals, recommended that two of his 8-inch guns be prepared for trials. At Brest in January 1824, twelve shells from these guns burst upon the old eighty-gun ship Le Pacificateure with terrible effect.[1]

The committee supervising these tests reported unanimously that the problems of shell-fire had been solved, that the interior of large ships was open to great destruction, as Paixhans had predicted, and that one explosion at the waterline could sink them. Moreover, by a majority of 13 to 3, they recommended that Paixhans' gun be introduced into ships of the line, "mais en petit quantité et en prenant des précautions qui doivent être l'objet d'une recherche et d'un examen special."[2]

In May 1824, Paixhans appeared before an enlar ed naval committee, chaired by the Minister of Marine and Colonies, to answer searching questions concerning the accuracy, dependability and safety of shells. He was able to produce acceptable factual evidence as to the first two qualities; but to convince senior naval officers who remembered the fate of L'Orient in 1799 of the safety of shells aboard ship, required all the

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1. Paixhans, Expériences Faites par la arine Française sur une Arme Nouvelle (Paris, 1825), pp. 37, 41-44.

2. Ibid. pp. 45-46. Baxter, p. 25.

persuasiveness Paixhans' sense of mission could bring to bear.

Attributing the explosions on *L'Alcide* and *L'Orient* to the fact that shells had been stacked on deck beside the guns, Paixhans advised mounting only four guns at the extremities of the lower decks, and supplying them from special shell rooms situated below the waterline. The committee recommended that a ship be prepared in this manner, and following repeated testing of shell fire at Brest in September and October of 1824, further recommended that shell guns receive sea trials.[1]

Apart from Paixhans' general references to improved metallurgy and his own work with shells, there is no information available to indicate in what manner shells had been improved from the dangerous and unreliable projectiles they had proved to be in the last years of the eighteenth century. Indeed, as shall soon be revealed, the French once more proved overly optimistic in believing the problems of shell fire had been solved. Nevertheless, the decision to embark on sea trials in 1824 was the

1. Paixhans, *Experiences*, pp. 57, 78-92.

first step in introducing shells into naval service. As such it did not go unnoticed by the British, who had not been slow to adopt uniform calibre after the French had done so, also in 1824.

In fact Britain had begun to show interest in shell fire soon after the war. For if the French had been unsuccessful with shells at sea during the war, this ammunition had become increasingly popular for coastal defense. Thus in 1813, at the siege of Danzig, the Nymph of the Danube had been destroyed by land-based shell fire, and according to Paixhans, a similar fate reportedly befell a British ship at the hands of an American Columbiad.[1] With these portents in mind, Sir Howard Douglas advised in 1817 that British seagunners be familiarized with shell practice from guns with common shells as well as with spherical case.[2] Although his advice was not taken, secret Ordnance experiments in late 1819 or early 1820 with elongated spherical

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1. Paixhans, Nouvelle Force, 109-110.
2. Douglas, 1st ed., p. 22.

case shot had a arently "succeeded perfectly."[1]

In April of 1820, Colonel William Mill r, an artillery officer at th Ordnance Department who specialized in naval armaments,[2] designed and had cast a 68-pdr. carronade, "applicable chiefly to naval purposes."[3] On 17 April, a committee of naval and artillery officers under Sir Thomas Hardy inspected Millar's 36 cwt. weapon, recommended that it undergo sea trials, and further suggested that a 50 cwt. experimental gun be cast. By May of the same year, the original carronade was mounted on H.M.S. Rochfort at Sheerness, and a year later, the year that Paixhans published his first edition of Nouvelle Force Maritime, the heavier gun had undergone seven months of

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1. Ibid. p. 304.

2. Dupin, Military Force, ii. 319. Apart from a very brief article in D.N.B., little is known about Millar, undoubtedly one of the foremost artillerists of the period. Millar was appointed 2/Lt. in the Royal Artillery in 1781 and served 18 years in the West Indies. In 1804 he was appointed as an assistant to Colonel Page at the Royal Carriage Department. In 1827 he b came Inspector, in 1833 Director of Artillery. He committed suicide in March 1838.

3. Adm.1/4024, Ordnance to Admiralty, 12 April 1820.

continuous testing at Woolwich, and was assigned to H.M.S. Northumberland.[1]

The original carronade was of 36 cwt., with a distribution of metal probably similar to Congreve's 24-pdr. medium ship gun of 1813, to give strength around the Gomer chamber in its breech. In comparative trials with the regulation 68-pdr. carronade, Millar's weapon excelled. It was worked much more rapidly by a crew of six men (as against eight or ten for the regulation carronade) and was much more destructive within its range than were 24- or 32-pdr. guns. But if the Admiralty had nurtured any hopes that the new ordnance would solve the maximum calibre problems discussed in the preceding chapter, they were quickly disillusioned; at five degrees elevation, Millar's gun ranged some 400 yards less than the long 32-pdr.[2]

Considerable mystery surrounds these first two Millar guns.

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1. Adm.1/4024, Ordnance to Admiralty, 15 May 1820, 18 April 1821 and minutes.

2. Adm.1/590, Admiral Sir B. Hallowell,to Admiralty 17 April 1820, enclosing Millar memo. 15 April. W.O.44/498, Rear Admiral Sir John Gore to Admiralty, 22 June 1821, enclosing Sir Thomas Hardy to Gore, 16 June, and reports of 12 and 21 June.

Surviving descriptions of the weapons and their testing are vague, and it is not clear that they were in fact tested with shells, or that the Admiralty considered them primarily as shell guns. Only in their inventor's mind was there little doubt as to their true purpose. Millar consistently referred to the 50 cwt. model as an 8-inch gun, in contrast to those officers who considered to to be no more than an improved carronade, and in 1829 revealed that "I have had it always in mind that this projectile [hollow shot he had designed for this gun] might also be used with good effect as a shell."[1]

It appears probable that neither the Millar gun or carronade receiving sea trials in 1821 was tested with shells. For in May of that year General Alexander Farrington, President of the Select Committee, adverted to the fact that carronades had never been adequately tested with hollow shot and shell, although they had been designed to fire these projectiles, and had been in

1. Adm.1/4028, Ordnance to Admiralty, 30 March 1829, enclosing Millar report of 21 March.

service for more than forty years. Farrington believed that the advent of Millar's guns presented the opportunity to experiment with shell fire from both 68-pdr. guns and carronades, and advised the Admiralty that three types of projectile, 68-pdr. solid shot, hollow shot weighing 52 pounds, and 8-inch shells of 47 pounds, be tried in these weapons. He further recommended that shells "be found at every station to which ships of war may proceed to refit after an action."[1]

The unpreparedness of the ports to receive shells in 1845, indicated that the advice to store this ammunition in 1821 was not followed.[2] There is also little evidence to indicate that the shell trials desired by Ordnance were in fact carried out. Nevertheless there was consi erable activity with 68-pdr. guns and carronades between 1821 and 1824, and when in the latter year France followed up the trials at Brest with sea trials for shell, the Admiralty ordered the 50 cwt. Millar

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1. Adm.1/4024, Ordnance to Admiralty, 7 May 1821, enclosure and minute.

2. W.O.44/502, Reports from Civil Officers at the various ports, 28 and 29 Nov., and 1, 3, 4 and 13 Dec. 1845.

gun mounted on quarter decks and forecastles.[1]

France was not the only power capable of revolutionizing naval warfare through the introduction of shells. In 1825 and 1826, declining Anglo-American relations over Latin America attracted British attention to the American Navy. Small in numbers but with powerful artillery, the steam frigate Fulton, and an undetermined number of Columbiad shell guns, the Americans could be formidable, especially in alliance with France. As already described, the British had taken immediate action to increase the broadside weight of metal of their frigates and ships of the line. They also tested an elongated shell similar to that introduced by the Stevenses in 1814.

This "cylindro-conical percussion shell" was designed and first tested by the Commandant of Leith Fort, Colonel George

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1. Ind.4952: 59-4, 12 and 17 April, 1820; 4958, 12 April 1821; 4964, 20 Aug., 4, 10, 12, 18 and 23 Sept., 3 Oct. 1822; 4970, 13, 17 and 25 Sept. 1823. Douglas, 3rd ed., p. 217. It is unlikely that many ships carried these guns as there were, by 1829, only 34 cast, although they had been "for some years adopted" by the navy. Adm.1/4028, Ordnance to Admiralty, 1 Jan, 1829, enclosing Millar report of 29 Dec. 1828.

Miller.[1] Encouraged by Miller's results, Ordnance conducted official trials at Woolwich in April of 1826. During the first test held on 8 April, 21 Miller shells were fired from a 9-pdr. field piece at the sloop Pheasant. The ranges were 320 and 450 yards. From these shells, only eight hits were secured, and of these three failed to explode on impact; the remaining shells either burst prematurely or grazed short of the target without bursting.[2]

To discover the reason for such a low percentage of effective hits, nineteen shells were prepared without bursting charges and fired through a screen at a butt. When the eight shells that had lodged in the butt were recovered, only two of them were found to have entered cone-foremost as intended, while the remainder had impacted side- or end-foremost, thereby failing to activate the percussion fuze in the nose. Two similar tests on 15 and

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1. Adm.1/4025, Ordnance to Admiralty, 18 Feb. 1826, enclosing Colonel George Miller to Ordnance, of the same date, and minute.

2. Adm.1/4032, Ordnance to Admiralty, 18 March 1836, enclosing Select Committee Report of 17 April 1826.

17 April 1826 produced similar results. The Select Committee conducting the trials therefore c ncluded that cylindrical projectiles "can never be attended with any satisfactory precision of direction, and the sentiments of the committee remain unchanged as to the extreme danger of introducing percussion powder into the Service."[1]

Colonel Miller protested that his shell should not be abandoned on the basis of this report. He believed his projectile capable of great improvement and deserving of trials from heavy naval guns, rather than 9-pdr. field pieces. Moreover, he complained, the committee had omitted any mention of the damage sustained by Pheasant, which had in fact been set on fire. "Let the Navy of England mark well the march of events in France and America," snapped Miller, "as at no distant time they may get a lesson upon the subject in more eloquent language than I

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1. Ibid. Dupin and Paixhans in France also believed that elongated shells were inferior to spherical. Dupin, Voyages, ii. ii. 134-35; Paixhans, Nouvelle Force, p. 137, note.

can use."[1]

Miller's remonstrance was unnecessary. For it was undoubtedly owing to awareness of the trends in France and America that his shell had been officially tested in the first place. It was this same vigilance that had persuaded the Admiralty to order Millar shell guns in 1824, and to take the tremendous pains described in Chapter Three to prepare the Royal Navy for the adoption of uniform calibre. Further reports of French plans for shells and steam, together with published accounts of the successes of both in various parts of the world, lead the Admiralty to take the first reluctant steps toward introducing shell guns and steamers into the navy. And although it is beyond the scope of this work to study closely the advent of steam, some attention to this important aspect of Paixhan's "nouvelle force" is essential.

Apart from having encouraged the Third Earl of Stanhope's design of the steamer <u>Kent</u> in 1792, the Admiralty showed slight

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1. W.O.44/500, Colonel George Miller to Ordnance, 13 May, 1826.

interest in steam as a motive power for naval vessels until after 1815. Between these years British progress in this field was confined to such examples of private enterprise as William Symington's Charlotte Dundas, which by 1803 was towing barges on the Forth-Clyde canal, and the Clyde built Thames which steamed from Greenock to London in 1815.[1]

In that year, the American steam frigate Fulton underwent successful trials. As large as a ship of the line, capable of doing six knots, and mounting 32-pdrs. prepared for firing shot heated in her boilers, the Fulton's success apparently made little lasting impression on Admiralty thinking. For while Melville, the First Lord, immediately ordered the steam sloop Congo built, that ship eventually sailed to the river of the same name under canvas, while its engines pumped water at Plymouth. In 1816 Melville was firmly against studying the possibilities of steam, apart from its application to tugboats for towing warships out of harbour against contrary winds or tides.[2]

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1. Bartlett, Sea Power, pp. 196-97.
2. Ibid. pp. 197-98. Sir John Barrow, An Auto-Biographical Memoir of Sir John Barrow (London, 1847), pp. 388-89.

To this end the packet Regent was hired in 1817 for conversion to a steam tug, but alterations were never carried out, probably owing to reasons of economy. In any event, another packet, the Eclipse, failed two years later in attempting to tow a 74 from Woolwich to Chatham against strong tides. Despite this setback, the Admiralty continued to experiment cautiously and on a limited scale with steam.[1] In 1821, they purchased the Monkey of 212 tons and eighty horsepower, and the following year built the Comet at Deptford. At least fourteen such vessels, mostly serving as packets and tugboats, but also used to provide information on the possibilities of steam for warships, were built for the Royal Navy between 1821 and 1831, and more than thirty steamers built between these years eventually came into naval

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1. Bartlett, pp. 199-200. Barrow, pp. 390-91. G.S. Graham, "The Transition from Paddle-wheel to Screw Propeller", M.M. xliv. 37. See also B. Brodie, Sea Power in the Machine Age (Princeton, 1941), pp. 18-25.

service.[1]

Although the Admiralty in the eighteen twenties used steam for non-combative purposes, steamers gave the first practical demonstrations of their value for warlike purposes during those years. U.S.S. Seagull had participated in the extermination of piracy in the West Indies in the first years of the decade, and in the First Burmese War of 1824-25, the East India Company steamer Diana proved invaluable time and again in towing transports and gun platforms against the powerful currents of the Irrawaddy.[2]

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1. For a list of the services of naval steamers until 1831, see Bartlett, p. 200. P.P.(1831-32), xxxiv. 265-66. See also Adm.95/86, Steam Register of 1848, fos. 106-7, 111-13, 118, 120, 125-30, 139-47, 150-51, 159-60, 169. Only two of the steamers listed in Bartlett and P.P. were armed. These were Messenger, built in 1824, and Columbia, built in 1829. Both were Mediterranean packets mounting two guns, and Douglas (3rd ed., p. 217 and note) indicates that the earlier steamer carried a shell gun.

2. Bartlett, pp. 199-200. Lieutenant John Marshall, The Naval Operations in Ava, during the Burmese War (London 1830), pp. 2-4, 25-27, 33, 37-38, 57, 67-70, 73, 79-80, 110-11. Brodie, p. 21.

More widely known were the services of the Karteria during the Greek struggle for independence. The London Committee for the Greek Cause had been persuaded by Lord Cochrane, newly returned from his triumphs in Latin America, to built six steamers armed with bow and stern long-guns. Even the smallest of these vessels were to be "capable of carrying the heavy guns [Millar 68-pdrs.] for firing eight-inch shells."[1]

Of these ships, only three were completed and only the Karteria saw much action. Underpowered, and subject to recurrent breakdown, she nevertheless used her eight 68-pdrs. to fire some 18,000 shells without accident, and with considerable effect. She inspired fear in her enemies ashore and afloat, causing

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1. Add. MSS. 36462, Frank Abney Hastings to J.C. Hobhouse, M.P., 9 May 1826. For other comments by Hastings on these vessels and their armaments, see Add. MSS. 36461, fos. 278, 391-92, 407-08; 36462, fos. 115, 126, 253, 305, 331; 36464, fo. 16; 36544, fos. 166, 187, 191. The British Government kept a close surveillance on the construction and preparation of the steamers. Add. MSS. 41396, Martin to Sir John Barrow, 3 July 1826; 36461, fo. 278.

conventional enemy warships to tow their gunpowder behind them in the manner of mortar vessels to avoid being blown up by her shells, or by shot heated in her boilers. The Greeks had a similar respect for a former Margate packet mounting three guns in the Egyptian service.[1]

Although it was probable that these hopelessly inefficient vessels were regarded by some observers with greater awe than they in fact merited, it is nevertheless true that their exploits attracted considerable attention in Britain. Throughout 1827 and 1828 there arose in England a spate of public speculation concerning the impending naval revolution with its "prosoects the most disast~~e~~rous and most humiliating" for England.[2]

Thus in 1827, Vice Admiral Charles Stirling's belief that

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1. Bartlett, pp. 200-01. Sir John Barrow, Memoir of the Life and Services of William Barrow (London, 1850), p. 12. F.A. Hastings, Memoir on the Use of Shells, Hot Shot, and Carcass Shells, for Ship Artillery (London, 1827). Naval and Military Magazine, 1828, iv. cxli-cxlii.

2. Naval and Military Magazihe, 1828, iv. 243.

steam would revolutionize the Royal Navy[1] was accompanied by Rear Admiral Sir John Ross's inability to reflect on that force, "without some feeling of doubt, whether the destiny of Great Britain may not at length be involved in this very invention, whether its fate will not even be sealed...."[2] In the following year, two testimonials to the effectiveness of shell fire were published, one posthumously by Captain Frank Abney Hastings of the Karteria, the other by Sir Sam Bentham on his experiences with the projectiles in the Sea of Azov in the late eighteenth

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1. Sir Charles Stirling, A Letter on Professional Topics, etc. (Chertsey, 1827), pp. 53-54. Stirling was at Quiberon in 1795 and Cape Finisterre in 1805, and was naval commander at the reduction of Monte Video in 1807. In 1811 he became C.-in-C. Jamaica, and then second in command to Warren on the North American Station when the two stations were amalgamated. Returned to England in 1813, died 1833. O'Byrne's Nav. Biog. Dict.

2. Sir John Ross, Treatise on Navigation by Steam; and an Essay towards a System of Naval Tactics peculiar to Steam Navigation etc.(London, 1828), introduction, p. xv. Naval and ilitary Magazine, 1828, iv. 244. Ross (1777-1856) is most famous as an Arctic explorer. In 1818, 1829 and 1849 he searched for the orth-west passage without success. In the second voyage (1829-33) he surveyed Boothia Peninsular and discovered the magnetic pole. D.N.B.

century.[1] Although Bentham's sm ll vessels were propelled by sail and oar, he was convinced that the advent of steam would increase the efficacy of small boats and shell guns, and that Britain should set about adopting these new forces before their "superior efficiency should have been proved to us by the success of some enemy."[2] The opinion of various writers and reviewers was that recent events had proved Paixhans "no idle, shallow visionary",[3] and that Britain should boldly assume the lead in developing satisfactory shell guns and steamers.

The Admiralty showed no immediate signs of sharing this sense of urgency. Indeed the only anxiety concerning the navy's adequacy at this time, appeared to be directed toward enlarging ships of the line to bear the wei ht of uniform 32-pdr. armaments.

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1. Sir S. Bentham, Naval Essays (London, 1828), pp. 52-57, 70-89.

2. Ibid. p. 89.

3. Foreign Quarterly Review, June 1828, p. 564. For other opinions see Ibid. pp. 566-91; Naval and Military Magazine, 1827, ii. 588, 686-87, and 1828, iv. xxv-xlv, cxli-cxlii; Napier, The Navy, pp. 42-43, 47-55, 63-64.

Thus, Sir William Congreve's proposed "steam vessel battery" mounting five hundred tons of armour to make it imp rvious to shot or shell, and suggested to Clarence in 1828, apparently received no serious official study. Byam Martin, the Controller, doubted that such a vessel could be made seaworthy, or a sufficiently powerful engine devised.[1]

The Admiralty were perhaps encouraged to believe that there was no great urgency in providing shell guns and steam vessels as a result of experiments conducted by the Royal Marine Artillery. Early in 1827, the same Lieutenant John Harvey Stevens, R.M.A., who had suggested arming gunboats with shells during the war, had conducted a series of experiments at the Royal Marine Laboratory. Stevens believed the French trials at Brest in 1824 had merely demonstrated the obvious. They had proved, "if any proof were wanting", that 8-inch shells could be destructive; they had not proved the projectiles reliable.[2]

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1. Add. MSS. 41397, Martin memo. 14 April 1828.
2. Adm.1/3357, Lieutenant Colonel Sir Richard Williams, R.M.A., to Admiralty, 2 March 1827, enclosing report of J.H. Stevens.

In fact, during the second series of French experiments in the autumn of 1824, over half the shells fired had malfunctioned, largely owing to faulty fuzes.[1] Paixhans himself confessed the fuze to be the major weakness in shell fire,[2] and it was to this "great defect" that Stevens turned in challenging "some of the assertions contained in the publication entitled Nouvelle Force Maritime."[3]

Two types of common fuze, a regulation issue and one of Stevens' own design, underwent a series of six tests. Neither model was satisfactory. Both would burn properly when submerged, but were extinguished if they struck the water with the slightest impact. When fired over water from 8- and 10-inch howitzers, only one shell burst after the first graze, and none survived the second. Stevens concluded that until adequate fuzes could be provided, or until naval gunnery became sufficiently accurate to avoid ricochet, existing fuzes would "greatly lessen the destructive effects that would otherwise result from

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1. Paixhans, Expériences, pp. 53-56.
2. Paixhans, Nouvelle Force, pp. 193-95.
3. Adm.1/3357, Williams to Admiralty, 2 March 1827 and enclosure.

the introduction of M. Paixhans' system." For this reason Stevens advised the Admiralty that little benefit would be realized from the introduction of shells at that time, and the Admiralty agreed to await the result of other tests.[1]

It was not until April 1829 that a satisfactory fuze was forthcoming.[2] This delay undoubtedly contributed to the impression that the Melville Administration was less than anxious to undertake the necessary steps to revolutionize the navy. For Melville and his First Sea Lord, Sir George Cockburn, had won themselves an unenviable reputation for "retrograde proclivities"[3] by those contemporaries, who, like Paixhans, saw something of the part to be played in future wars by steam, shells and armour plate. In truth, both these men, in conjunction with Thomas Byam Martin, the Controller of the Navy, had been less than encouraging toward those suggesting such innovations. Sir William Congreve's proposed ironclad steam battery had been

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1. IBid. minute.
2. See below.
3. Briggs, Naval Administration, p. 8.

scorned by Martin. The more modest proposals of Sir John Ross for armed steamers for coastal defense, or of the Colonial Office for a mail steamer, both received the same reply:

> Their Lordships feel it their bounden duty to discourage to the utmost of their ability the employment of steam vessels, as they consider that the introduction of steam is calculated to strike a fatal blow at the naval supremacy of the Empire.[1]

Colonel George Miller, whose cylindrical shells had been so brusquely rejected at Woolwich in 1826, reported a similar attitude. The Admiralty had verbally confided to him that they objected to his projectile, not so much on the grounds of inefficiency,

> ...but they conceived that, if brought into use, it would bring about a change in Naval Warfare, which might be injurious to our Naval Superiority, and that therefore they would not be the first to introduce it...[2]

It is obvious, then, that Melville and Cockburn did not object to steamers merely because of their dirtiness or limited

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1. Ibid. p. 9, Bartlett, p. 202.
2. W.O.44/500, Colonel George Miller to Ordnance, 1 March 1836.

aesthetic appeal; nor was their reluctance to press ahead with shell guns necessarily owing to a violent prejudice against progress, as thwarted innovators charged. So long as Britain's naval supremacy could be maintained with the weapons at hand, it was in her interests to preserve those weapons; to herself undertake the great effort and expense of rendering her source of power obsolete would be absurd. As one observer succinctly put it: "Many of the defects which were known to exist, so long as they were common to all navies, operated to the advantage of Great Britain."[1]

No one recognized this fact more clearly than Paixhans, who was enjoying only slight success in convincing his compatriots that to challenge British naval supremacy France would need to assume the lead in solving the problems of steam and shell technology. Britain would never take the lead in this field, he pointed out, for as the nation with most to lose from a revolution

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1. T.F. Simmons, Heavy Ordnance, p. 2. In this respect see, too, Napier, The avy, pp. 203-07.

in armaments, Britain would be the last country to initiate this revolution "ce qui en definitif ne sera défavorable qu'à l'Angleterre."[1]

Britain ~~thus~~ had far too much to lose by initiating the adoption of shell and steam. Her existing fleet was capable of defending British interests in all parts of the world, in any capacity, and under all weather conditions. Steamers in 1828 could not.[2] Indeed, as Professor Graham has pointed out, the development of the war steamer was to take "long years of exacting experiment and wasteful expenditure" that could not be attributed "to any appreciable extent as the consequence of Admiralty or shipbuilder's conservativism and abhorrence of invention."[3]

Yet another reason why Britain felt little need to push

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1. Paixhans, Nouvelle Force, pp. 236-37; Force et Faiblesse Militaires de la France (Paris, 1830), pp. 401-03.

2. Bartlett, p. 205.

3. G.S. Graham, "The Ascendency of the Sailing Ship 1850-55", Economic History Review, ix. 1. 75. See Bartlett, pp. 202-05.

forward with the adoption of shell guns was the fact that she already possessed a proven delivery system for shells. This was the war rocket. The war rocket had undergone a brief but chequered history of combat and experiment before attaining the reliability necessary for service against naval and coastal shell guns. Supposedly understood but scorned by European powers since 1325, the rocket was first seriously considered as a military weapon by the British after it had been used against them in India in the 1790's. It was William Congreve who first produced a tolerably accurate rocket by using his own improved powders, positioning the stick at the center of the base, and by locating the exhaust vents on the periphery of the base. Nevertheless, the earlier versions used at Boulogne in 1806, and at Copenhagen and Flushing in 1807 and 1809, were often disappointing. Following brilliant success at Leipzig in 1813, they failed miserably at Quatre Bras when they turned on the British lines.[1]

Apart from their use as an anti-personnel and siege weapon for the military, Congreve anticipated that his rockets would replace the bomb or mortar vessels of the navy. The bombardments of Boulogne, Copenhagen and Flushing offered the Admiralty some encouragement in this respect, and rockets were issued to ships on the North American station for use along the American coast in 1814.[2]

At Algiers in 1816, rockets were used with such good results, that a special ship's boat was designed and approved for their use. Further trials were carried out in 1819. On land it was found that the rocket had been improved to the point

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1. On the Congreve Rocket, see Sir William Congreve, A Treatise of the Congreve Pocket System (London,1827); Clowes, vi. 190-91, 201; Dupin, Military Force, ii. 189-200; Glover, Peninsular Preparations, pp. 68-73; Hime, Artillery, pp. 144-48; Scoffern, Projectile Weapons, pp. 59-60; Paixhans, Nouvelle Force, pp. 31-36.

2. Adm.1/4021, Ordnance to Admiralty, 3 Jan. 1814 and 4 Feb. 1814. Ei ht thousand rockets were set aside for the navy, three thousand of which were sent to America; of these latter, one thousand were 12- and 32-pdr. shell rockets.

where it was more accurate at medium range than was field artillery, and comparable success was experienced firing them from the bo ts of H.M.S. Hyperion. The Congreve rocket was also considered by some to be the weapon most capable of dealing with the American steam frigate Fulton, should the occasion arise.[1]

By 1828, therefore, the rocket had proven itself a useful and effective weapon. Considering the primitive state of contemporary shell gunnery, there can be li tle doubt that the rocket was superior to any shell guns it might have to face. Moreover, the secret of its c nstruction had been so well kept that no other nation was in a position to match a British move to introduce rockets, thereby rendering ships of the line obsolete, not by shell guns as Paixhans had predicted, but by shell rockets.[2]

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1. Adm.2/1216, Admiralty to Sir Richard Williams, R.M.A., 3 and 6 July, 1816. Ind.4938: 59-4, 25 Aug., 9 Sept. 1817; 4947, 3 Aug. 1819. Dupin, Military Force, ii. 199. Bartlett, pp. 197-98. Parkinson, Exmouth, pp. 447, 462-64.

2. Glover, Peninsular Preparations, pp. 71-73. See also dm.1/4024, Wellin ton to Melville, private, 15 Feb. 1821.

The rocket could deliver solid shot, carcass or shells from small boats against ships or coastal batteries, while the mother ship stood beyond range of enemy shell fire. This "ammunition without ordnance ... the soul of artillery without the body",[1] as Congreve described his invention, was cheaply and quickly produced, required no costly and cumbersome launching apparatus, and was relatively safe and dependable. None of these qualities applied to existing shell guns, and thus the rocket was an excellent temporary expedient while the slow and expensive process of designing, casting and testing long-range shell guns was carried out.[2]

In November 1828, when Stevens and others had not yet succeeded in producing a satisfactory fuze, and when public

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1. W. Congreve, A Concise Account of the Origin, and Progress of the Rocket System, etc. (London, 1807), p. 7.

2. J.H. Stevens, Some Description of the ethods Used in Pointing Guns at Sea (London, 1834), p. 34. Scoffern, Projectile Weapons, p. 69. Naval and Military Magazine, 1828, iv. 145. Both Stevens and Scoffern point out that rocketry required practically perfect weather conditions.

controversy over Paixhans' new force was at its height, the Admiralty ordered rockets for the navy. Every ship of the line and every frigate in commission or ready to be brought forward, was to receive five dozen 24-pdr. shell rockets; lesser vessels were to be issued with three dozen 12-pdrs. The Royal Navy was thus assured of shell firing capability in the event France should introduce shell guns and war steamers on a large scale.[1]

In late 1828 it appeared that France was about to do just that. Reports indicated that she already possessed three more steamers than did Britain, and that her building program would substantially increase this margin in the near future, as well as increase her number of shell guns.[2] Under this threat the Admiralty moved with uncustomary boldness. On the first day of 1829, Cockburn, whom the Duke of Clarence thought no more fit

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1. Adm.1/4029, Ordnance to Admiralty, 15 April and 26 May 1831. These inform Admiralty that the rockets ordered on 29 Nov. 1828 and 7 May 1830 were completed. See also W.O.54/938, Sir Augustus Frazer to Sir James Kempt, 26 May 1831.

2. Bartlett, p. 206.

to serve as First Sea Lord "than any old grandmother",[1] anxiously requested Ordnance to immediately provide 10-inch Millar guns for trials with hollow shot and shells. Viscount Beresford, Master General of the Ordnance, promised to immediately set about preparing for trials and confessed, "I think you are quite right to try them."[2]

Trials were carried out in early February on two of the six 10-inch guns ordered by the Admiralty. One of the guns was designed to fire 68-pdr. shells, the other shells of 75 pounds. The larger gun was recommended on the grounds that its shell had superior penetration, and three more of this nature were ordered prepared for further experiment. At the same trials, shells weighing 112 pounds were successfully fired from 12-inch guns of 90 cwt., and a second such gun was ordered for trials

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1. Add. MSS. 41368, Martin Memo. 5 Sept. 1831.

2. Adm.1/4028, Viscount Beresford to Cockburn, 1 Jan. 1829 and minute.

in steamships.[1]

During the following month, efforts were made to solve the problems of horizontal shell fire that stemmed from faulty fuzes. It will be recalled that in 1827, Lieutenant John Harvey Stevens, having failed to provide satisfactory fuzes, had advised that until this problem was solved, the shell system would never have the effect predicted by Paixhans. Sir William Congreve at the Royal Laboratory had taken up Stevens' challenge, but had failed in his effort to convert a fuze he had developed at an earlier date for use with mortar shells.[2]

Not until March of 1829, two years after Stevens' report, did Colonel William Millar, the inventor of England's shell guns, submit a fuze for trial. Of the gunmetal construction advocated by Paixhans, and screwing flush into the fuze hole, Millar

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1. Adm.1/4028, Ordnance to Admiralty, 15 Jan. and minute, 6 Feb. 1829 and enclosures, 10 June 1829 and minute. The 10-inch guns were 7 feet 6 inches and 8 feet 4 inches, and weighed 57¾ and 62¼ cwt. The 12-inch guns never saw service.

2. Paixhans, Force et Faibless , p. 412.

believed he had overcome many of the defects of regulation fuzes. The latter, generally of beechwood construction, were adequate for the low velocities of mortar fire, but posed several problems when used in high velocity gunfire. In the latter instance, these projecting fuzes greatly reduced accuracy, and were frequently blown out of the shells by the concussion, or were snuffed out when striking the water or the target.[1]

Millar's fuze promised much greater strength and accuracy. Tested at Woolwich in April 1829, the Select Committee found it to answer their needs. Of three shells fired at a bulkhead, range 400 yards, one passed through the target and exploded in the air, the second lodged but did not explode, while the third lodged and "exploded with most powerful effect displacing beams both inside and out."[2]

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1. A good summary of the difficulties presented by fuzes at this time is to be found in Paixhans, Force et Faiblesse, p. 411, note F. See also above.

2. Adm.1/4028, Ordnance to Admiralty, 30 March 1829 and enclosures. See also W.O.44/500, Admiralty to Ordnance, 10 April 1838 and enclosures.

Millar had also provided a metal cap to screw over the fuze and thus protect it from accidental ignition. This device, tested by exploding a pound of gunpowder on the capped fuze without igniting it, was thought by Millar and the Committee to remove the dangers of shells on shipboard. The Admiralty agreed, and ordered that shell guns and fuzes be provided for sea trials. In June 1829, the Talavera received two 10-inch shell guns and forty live shells, to become the first British ship of the line to receive such armament.[1]

Steps were subsequently taken in 1830 to increase the number of shell guns in the fleet. Martin recommended that two armed steamers of 120 horsepower be laid down, and suggested mounting 8-inch guns on certain ships of the line. Melville replied that "if found to answer, all line of battle ships should have two large guns for shells or hollow shot." And instead of the

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1. Adm.1/4028, Ordnance to Admiralty, 18 May 1829 and minute, 10 June 1829 minute and enclosure. Majendie, p. 234, note 6.

two steamers recommended by Martin, the First Lord, after first implying that the question of steam was open to "further discussion and consideration", directed that nine steamers be laid down, four of 220 horsepower and five of 140 horsepower, both classes to be armed.[1]

More significant, as to the five ships of the line recommended by Martin, Melville ordered "no more be laid down or the materials prepared for the present." Thus, not only was Melville discontinuing the construction of ships of the line and frigates that could not sustain the weight of uniform 32-pdrs., the First Lord was in fact placing a moratorium on the construction of all large conventional ships until the policy best suiting British needs on the threshold of a new era could be decided.

With the accession of the Grey ministry in November of 1830, the responsibility for this decision fell to Melville's successor,

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1. Add. MSS. 41368, fos. 264-71, Martin abstract of proposed state of the Navy, 1830.

Sir James Graham. And although it a pears that Melville argued his case on the side of phasing out ships of the line in discussions with the incoming First Lord, Graham would have none of it. Highly critical of Melville's bid to provide no more ships of the line, "on the vague ground of anticipated improvement in steam", Graham wrote Martin in June, 1831:

> Strong language has been used in reprobation of building more large ships, at a time when the application of steam to maritime purposes is considered likely to give such a turn to Naval Warfare as to render large ships, as it is assumed, comparatively insignificant and useless.

While fully aware that war steamers and their shell guns would change the character of subsequent wars with France, Graham believed that so long as other n tions continued to build large ships, Britain was obliged to retain her capacity to fight on that basis. To Martin's delight, the new First Lord ordered five first-rates to be laid down, while retaining the remainder of Melville's bold policy.[1]

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1. Add. MSS. 41399, Graham to Martin, 16 June 1831.

Melville's policy of 1829 confirmed the fact that only eight years after the publication of Nouvelle Force Maritime, the naval revolution predicted by Paixhans had begun. War steamers mounting shell guns had become an acknowledged threat to the large wooden ship of the line. The mechanical inefficiency of steamers, together with their inability to fulfill such important requirements of naval warfare as undertaking ocean voyages and mounting blockades, convinced Graham that a sailing navy was still essential. He consequently departed from Melville's scheme by insisting that ships of the line continue to be built in addition to war steamers. Graham also disagreed with Melville on armaments. For while he accepted the scheme of uniform solid shot calibre combined with 8- and 10-inch shell guns, the new First Lord was reluctant to adopt the actual gun models selected by his predecessor. In fact the search for suitable guns was to occupy the greater part of the thirties, and during this period the Royal Navy's armaments were a curious mixture of 24-pdrs. bored up to 32-pdrs., and a few unsatisfactory shell guns. But if Graham and Melville differed on many points, on one they were in complete agreement: without highly trained gunners, the shell system would be useless and dangerous.

Cha ter Five

THE ESTABLISHMENT OF H.M.S. EXCELLENT

Melville's abrupt decision to introduce the shell system was not taken ithout considering the fears and dangers that had kept shells out of British warships until 1829. It was realized that highly trained crews would be required if this complex and dangerous ammunition were to be used effectively and with safety. And yet the Battle of Navarino had indicated that the average British gun crew could not competently handle simple solid s ot, and that the Royal Marine Artillery had failed to adequately train naval gunners in the use of the sights, tubes and gunnery manuals introduced a decade before. Poor gunnery at Navarino caused many naval officers and artillerists to renew their demands of 1817 for a gunnery training depot, and in 1830, following the introduction of the shell system, Melville established a training school aboard H.M.S. *Excellent* at Portsmouth. This ch pter discusses the reasons for *Excellent*'s establishment, her contribution to the gun ery of the fleet, and her influence on the Admiralty-Ordnance relationship following Graham's reorganization of the n val administration.

In 1829 the Melville Administration took the first step in the changeover from existing sailing ships of the line and their solid shot armament to steam warships armed with shell guns. Melville's successor,[1] Graham, modified his predecessor's radical proposals only by insisting that conventional warships continue to be built in addition to steam vessels. Another innovation of Melville's in 1829, and one resolutely carried through by Graham, was the establishment of the gunnery training ship H.M.S. Excellent at Portsmouth.

After the War of 1812 many naval and artillery officers and artillerists had advocated some form of training unit for naval gunners. In particular, Sir Howard Douglas, in his first edition of Naval Gunnery, had been at great pains to oint out the benefits

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1. See above, Chapter Four.

to be derived from a naval gunnery ship; and although in 1817 the Admiralty had chosen to make do with the Royal Marine Artillery for training purposes, by 1829 events and technical developments had brought home the wisdom, indeed the necessity, of a regular gunnery training depot for the navy.[1]

There were three main reasons for the establishment of Excellent: (1) an effective shell system necessitated increased accuracy in gunnery; (2) the improved accuracy of naval guns resulting from advances in sights and tubes demanded more sophisticated gunnery techniques; and (3) the failure of the Royal Marine Artillery to adequately train a sufficient number of naval gunners, as revealed in the Battle of Navarino in 1827, resulted in a renewed and vigorous campaign by influential individuals to establish a gunnery training depot.

The introduction of the shell was perhaps the most important of these reasons. In the first place shells were more complex

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1. See above, Chapter Two, for steps taken to improve gunnery after 1815.

and dangerous projectiles than solid shot, and gunners had to be specially trained to handle them carefully, not only in filling them and moving them from shell room to gundeck, but also in uncapping the fuze and loading the ready shell into the gun. In short, shells called for safety and safety demanded rigorous training.

A second reason why shells called for intense training was in the nature of their construction. Casting a homogeneous shell "skin" was beyond the metallurgical skill of the period, with the result that faulty metal and imperfect sphericity caused irregular flight, an irregularity aggravated by the imbalance created by the positioning of the fuze. Moreover, as Lieutenant John Harvey Stevens R.M.A. had discovered in 1827, when shells grazed the water either as a result of such imbalance or because of deliberate ricochet fire, their fuzes were snuffed out. Stevens felt this to be the "great defect" of Paixhans' shell, and concluded in his report:

> -... still one advantage it is hoped has resulted from this investigation, viz. That ricochets with shells on

> the water will be justly distrusted, and that the necessity of a careful and accurate management of the arm in question will be evident, to ensure the shell's striking the object without grazing, as often as it can be so attained.[1]

Not only were shells less accurate than solid shot, they were inferior in range. This was caused in part by the fact that early shells could withstand only moderate detonating charges if they were not to burst in the gun. But a more important limiting factor was the low specific gravity of shells: as they were considerably lighter for their size than shot, their initial velocity was much more quickly retarded by air resistance and by gravity. Thus, in the early thirties, the optimal effective range of an 8-inch shell weighing 48 pounds was at the most 800 yards, while that of the 6-inch 32-pdr. solid shot then in service was of the order of 1300 yards.[2] This immediately suggested that

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1. Adm.1/3357, Lt. Col. Sir Richard Williams, Commandant R.M.A., to Admiralty, 2 March 1827, enclosing Stevens to Williams of the same date.

2. It is interesting to note in this respect that in tests held at Southsea in 1838, 10 out of 11 32-pdr. shot struck the target, compared with 3 out of 11 8-inch shells. The range was only 400 yards. Adm.1/4034, Ordnance to Admiralty, 29 Oct. 1838, enclosures.

the best defense against shell guns was to knock them out with heavy solid shot fired from beyond 800 yards. In other words, the introduction of the shell system not only demanded that gun crews for shell guns receive adequate training, but that gunners be able to fire solid shot accurately at long range. Hence the need for a training depot such as Excellent to provide a high standard of gunnery throughout the fleet.

The adoption of the shell system in 1829 clearly encouraged the decision officially taken the following year to establish Excellent. There is nevertheless considerable evidence to suggest that Melville's administration was considering the desirability of such a move even before the advent of shells made a training depot essential. This evidence is to be found in the increasing interest taken in gun accuracy and gunnery training following the Battle of Navarino in October 1827.

In the course of this four hour demonstration British expenditure of ammunition was immense but the destruction wrought comparatively small. The Asia, Albion and Genoa alone pumped 122 tons of shot in the general direction of the Turkish fleet, much of the Genoa's share striking the Albion, and this despite the fact that the engagement was fought at anchor in an enclosed harbour. There were reports by gunnery lieutenants of lower deck guns having been fired without any breeching to retain their recoil and of at least one gun having been loaded with six shot, "the last having been put in for luck."[1] Young William Barrow, who commanded three guns during the engagement, may have been writing with studied nonchalance when he informed his father, the Second Secretary to the Admiralty, that "I fired now and then, and hit a corvette twice." Nevertheless his words would appear to accurately describe the haphazard manner in which the British bombardment was carried out.[2]

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1. A.W. Jerningham, Remarks on the Means of Directing Ships' Broadsides (London, 1851), pp. 34-35. See also A. Macdermott, "Guns and Gunners of Olden Times", M.M. xliv. 148-50. Simmons, Heavy Ordnance, 117-18. Bartlett, Sea Power, p. 39. W.O.44/499, Captain T.F. Simmons to Ordnance, 17 Jan. 1831.

2. Sir John Barrow, Memoir of Life and Services of William Barrow (London, 1850), p. 24. For a more general view of the whole action, see C.M. Woodhouse, The Battle of Navarino (London, 1965), pp. 10-41.

The abysmal standard of gunnery at Navarino testified to the failure of British gunners to make effective use of the recently introduced sights, locks and tubes, and revealed the complete failure of the Royal Marine Artillery to instruct seamen in the correct handling of guns. Throughout 1828 steps were taken to improve both the mechanics and the art of naval gunnery. Attention was first paid to gunsights.[1]

First officially adopted in 1819, it was not until 1828 that sights were "introduced universally" into the Royal Navy. By 1827, however, at least six different types of sight had found their way into the service. Early in 1828, a committee including Admirals Sir Pulteney Malcolm and Sir Thomas Hardy, tested in the presence of Sir George Cockburn and the Lord High Admiral, every model of gunsight in service or proposed for service, and recommended that a design of William Millar's

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1. Adm.1/4026, Ordnance to Admiralty, 3 Dec. 1827; 4027, 4 Feb. 1828. See also Ind. 5009: 59-4, 11 Feb., 21 and 28 April, 7 and 16 May, 1828.

be adopted.[1]

In fact both Millar and Congreve sights were to be issued to all guns in commision, depending upon the preference of individual captains. In late 1829, the Admiralty again decided to reduce the variety of sights, this time from two to one; all manufacture was suspended until 16 ships, selected to test and compare the two patterns, could report. In the end Millar's sights were adopted.[2]

By equipping all naval guns with improved gunsights the Admiralty had taken an important step towards increasing the potential accuracy of its artillery. A second effort in this direction, also made in 1828, was to increase the accuracy of the projectile by the better preservation of shot. This cast iron ammunition had usually been left to rust in stowage until required for use, at which time the rust was beaten off by

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1. Adm.1/4025, Ordnance to Admiralty, 20 Jan. 1824; 4026, Millar to Ordnance, 4 Sept. 1827. W.O.44/500, William Millar to Ordnance, 16 May 1837.

2. Adm.1/4028, Ordnance to Admiralty, 6 Nov. and 10 May, 1830; 4029, 9 May 1832.

hammers or in special hoppers which jostled the shot together. Methods such as these left the surface of the ball pitted and irregular, causing inaccurate fli ht. Sir Howard Douglas was the first to advocate a more careful handling of shot, and in 1828, Ordnance, having tested various types of preservative, ordered that lacquered shot be provided for the Royal Navy.[1]

In addition to improving sights and shot surfaces, a third modification in existing materiel was undertaken in 1828. This was the attempt to increase accuracy by reducing the time lapse between touch and discharge. Captain Fynmore's quill tubes, adopted after 1815, had slightly reduced the interval of time which elapsed between firing the tube and actual ignition of the charge. This in turn served to reduce the difference in muzzle position relative to the target at time of aim and time of ignition, owing to ship or target movement. It had long been the desire of many artillerists to use a powder so rapid burning that the moment of touch and the moment of discharge would be

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1. Douglas, 1 t ed., pp. 84-86. Adm.1/4027, Ordnance to Admiralty, 25 June 1828, enclosures.

practically simultaneous. Such powders h d been in existence from early times. It h d been impossible, however, to develop a metal for vents which was capable of withstanding this violent combustion, and even had such metals been available, the large quantity of powder necessary for a warship issued with percussion locks would, in the words of a Select Committee in 1820, "be frau ht with such extreme risque" as to render it inadmissable at sea.[1]

During the 1820's all n vies strove to solve the problems of developing m tals capable of withstanding the violent action of percussion or muriatic powder, or alternatively, of taming the powder to a level where existing metals could withstand its action. It was not until 1829 that a surgery dispenser at Woolwich, a Mr. Marsh, had his hammers and tubes adopted for trial with the shell guns aboard H.M.S. Talavera.

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1. dm.1/4024, Ordnance to Admiralty, 12 M y 1820, enclosure. See also W.O.44/498, packet entitled "Locks on the percussion principle for great guns of H.M. ships, Jan.-Aug. 1820.". Percussion or muriatic powder differed from ordinary powder in that it contained axymuriate rather than nitrate of potash or saltpeter.

By 1832 they h d been issued to more than twenty ships of the line in commission, although Ordnance predicted that such locks would "be for some time li ble to occasional failure."[1]

Thus the ragged performance at Navarino had prompted Admiralty attention to the correction of various defects in the mechanics of gunnery. But improved locks, sights and projectiles could contribute little to improved accuracy so long as gun crews remained incompetent. Indeed, refining the mechanics of gunnery could be justified only be increasing the skill of gunners.

The Duke of Clarence, Lord High Admiral during 1827-28, was an e thusiast for good gunnery. Dismay over the standards revealed at Nav rino caused him to investigate the navy's gunnery situation in gen ral. He was not encouraged by what he found. Several ships had not exercised their guns once during

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1. Adm.1/4030, Ordnance to dmiralty, 11 May 1832. See also Adm.1/4027, 16 Jan. 1828 and minute; 4028, 2 June and 19 Aug. 1829. A eneral review of percussion tubes is to be found in Dougl s, 3rd ed., pp. 384-96, and a particular description of Marsh's tube is to be found in Hogg, Royal Arsenal, II. 1834.

three-year commissions, and others h d done so with varying frequency and dedication. Captains who strove for gunnery excellence by exercising frequently and according to the established manual were rare, for such practice interfered with the day-to-day working of the ships, spoiled the paintwork, and scarred the holystoned decks.

Between January and March 1828 Clarence directed his influence toward improving gunnery. He insisted that each ship make quarterly returns of gunn ry exercise and ammunition expenditure, and urged that guard-ships should also put to sea for practice. He attended the trial of gunsights already mentioned, invited Sir Philip Broke of Shannon fame to submit suggestions regarding gunnery practice, appointed a committee to review the gunnery system adopted in 1817, and discussed with Byam Martin, the Controller, the possibility of fitting out a guard-ship as a gunnery school.[1]

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1. Add. MSS. 41397, Martin memo. 23 June 1827. See also Barrow, Auto-Biographical Memoir, pp. 338-41, 367-70, 386; Bartlett, pp. 39-40; Bowles, p. 48; Briggs, pp. 1-8; Brighton, pp. 350-53.

Clarence was not alone in discovering that the Order in Council of August 1817, establishing a gunnery drill to be given to naval gunners by the Royal Marine Artillery, had become a dead letter. In 1824 and 1825 the Admiralty had, with no discernable result, reminded all captains of their obligation to exercise their guncrews regularly in accordance with that Order.[1] Captain John Pechell answered publicly from *Sybille* at

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1. Ind.4977: 59-4, 28 Aug. 1824; 4985, 10 Mar. 1825. The Marine Artillery's early efforts had been impressive. By 1820 there were naval guns and carronades mounted at each of the four divisional headquarters, Woolwich, Chatham, Portsmouth and Plymouth, and upwards of 1500 marines and seamen had been trained to the naval drill. Three headquarters moves in two years, from Fort Monckton to Chatham to Portsmouth, had left the unit in disarray and demoralized, contributing to the resentment against what was held to be an imposition on the part of the navy. After 1822 it appears that few marines or seamen were instructed in the drill. Adm.1/3356, Colonel Sir Richard Williams to Admiralty, 17 June, 11 July, 1 and 6 Sept. 1824, Melville to the Duke of Norfolk, 23 June 1824; Adm.2/1226, Admiralty to Ordnance, 19 and 22 July 1822.

Corfu that he could see no evidence of a standard gunnery manual in the navy, and that most ships' companies were still being "more or less instructed according to the ability and inclination of their officers."[1] Pechell, criticizing the Admiralty for having failed to adopt Sir Howard Douglas's scheme for a gunnery school in 1817, advocated setting up a Senior Department at Portsmouth on the lines of Douglas's at Farnham, and urged that the rank of Gunner of the Fleet be revived so that Flag Officers could be assisted in their yearly inspections by an artillery expert.[2]

The following year, 1826, two senior naval officers, Admirals Sir Alexander Cochrane and Sir Willoughby Lake, supported Pechell's estimation of British gunnery standards, and pointed to the rigid adherence to gunnery training in France and America. Captain George Smith, who in 1830 was to become the first

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1. Pechell, Defective Ships' Guns (Corfu, 1825), p. 12. In 1820 Douglas had still not seen a copy of the manual of 1817. Douglas 1st ed., pp. 143-45.

2. Pechell, pp. 1-8.

commander of Excellent, also expressed concern over the state of naval gunnery and urged the Admiralty to set up a training ship such as Douglas had suggested.[1]

Navarino confirmed the fears of Cochrane and Pechell, Lake and Smith, and in 1828 the Admiralty, under Clarence, undertook the steps already described to improve gunnery. In 1829 Sir Howard Douglas brought forth a timely second edition of Naval Gunnery. Although he could not make alterations to the text

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1. Adm.7/712, Rear Admiral Lake to Admiralty, 20 Nov. 1826, and Cockburn to Melville, 24 Dec. 1826, enclosure; Adm.1/3155, Smith to Admiralty, 6 Feb. 1826. Cochrane, uncle to the more famous 10th Earl of Dundonald, was at the time of his report living in Paris, having last regularly served as Port Admiral at Plymouth (1821-24). He had also spent much of his earlier career in the West Indies, and in 1814 commanded on the North American station. Lake served with him at the same time, and returned to North America as Commander-in-Chief, Halifax. It was during this posting that Lake made his report on American enthusiasm, at a time, it will be recalled, when the Admiralty was concerned over the large ships and heavy broadsides of the American Navy. O'Byrne's Nav. Biog. Dict. D.N.B.

from the remoteness of New Brunswick, where he was now Lieutenant Governor, Douglas pointed out in his preface that the French were using a translation of his first edition in their naval colleges and were studying it much more seriously than were the British. He urged the Admiralty to pay more attention to the new edition than they had to the first.[1]

Douglas's arguments were reinforced by Commander George Smith's second plea for a gunnery ship, submitted to the Admiralty in October 1829. Smith pointed out that the adoption of sights, percussion locks and the shell system was all very well, but that their usefulness was limited "for the want of some ably-instructed person to explain them." He urged, as Sir Howard Douglas had in 1817 and again in 1829, that a ship be established to train seamen gunners in all aspects of gunnery.[2] Another supporter of Douglas's scheme, Captain William Bowles, brought

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1. Douglas, Naval Gunnery (London, 1829), xiv. See also F.E.A. Charpentier, Traité D'Artillerie Navale (Paris, 1826), passim.

2. Adm.1/2557, Smith to Admiralty, 7 Oct. 1829, enclosure entitled "Prospectus of a Plan for the Improvement of Naval Gunnery, without any additional Expense."

Smith's argument before the public in a pamphlet published in early 1830.[1]

Finally, on 19 June 1830, the Melville administration decided to establish H.M.S. Excellent at Portsmouth as an experimental gunnery ship. Smith was appointed her first commander. By August the first detachment of 40 instructors from the Royal Marine Artillery was on board, and the Ordnance Department had delivered most of the weapons and equipment considered necessary by Smith. Sir Howard Douglas returned to England in the summer of 1830 to receive the congratul tions of both Smith and Pechell on Britain's attainment of the establishment

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1. See Bowles, Naval Pamphlets, pp. 1, 48-64. Bowles had joined the n vy in 1796, and after service on several stations was appointed Commander-in-Chief of the forces off Brazil (1813-20). In 1820 he married Palmerston's daughter, and in 1822 captained the Royal Yacht William a d Mary. From 1823-41 he was Comptroller General of the Co st Guard, on the Board of Admiralty 1844-46, and M.P. for Launceston in 1848 and 1851. The pamphl t in question was the first of several dealing with various n val problems, particularly that of manning. These were gen rally signed "Flag Officer" and h ve been erroneously attributed to Sir Ch rles Penrose.

he had so long desired to see in the navy.[1]

The raham administration granted Excellent permanent establishment in 1832, with the twofold purpose of training gunners and experimenting with new gunnery equipment proposed for service.[2] The experimental part of Excellent's duties are described below. First, ho ever, it is necessary to describe briefly her role as a gunnery training ship.

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1. Adm.1/3472, draft of Admiralty Order on the management of Excellent, 29 Sept. 1830; 4029, Ordnance to Admiralty, 23 June 1830. See also Bartlett, p. 41; C. Lloyd, "The Origins of H.M.S. Excellent", M.M. xli. 193-97; R.D. Oliver, ed., H.M.S."Excellent" 1830-1930 (Portsmouth, 1930), pp. 10-21; R.T. Young, The House That Jack Built; th Story of H.M.S. "Excellent" (Aldershot, 1955), pp. 1-7; Douglas 3rd ed., p. 21, note. Smith had joined the Navy in 1808, made Lieutenant in 1815, Commander in 1829. His brief command of Excellent was perhaps uninspiring; in any case he was repl ced in 1832 and saw no further service except as sup rintendent of packets at Southampton in 1849. He died in 1850. Prior to his appointment to Excellent he had invented a "movable target" in 1825, and had twice written to the Admiralty in favour of a gunnery ship. D.N.B. O'Byrne's Nav. Biog. Dict.

2. ee Adm.1/3476, 13 April 1832, for the revision of the orders of 1830. See also Appendix B of this work.

Between 1832 and 1851, more than 3,500 gunners of all ranks (2,500 were able seamen) graduated from Excellent. Arrangements were also made to systematically train members of other services including the coast guard, the Royal Marines and men of the Ordinary. Thus, although there were seldom more than 200 trainees aboard Excellent in any given year during the thirties, their subsequent dispersal through the fleet brought high gunnery standards to gun crews that had never studied at Portsmouth. Indeed, by 1836 the Admiralty had found it necessary to set up a new sub section in its filing system to handle the immense correspondence dealing with the movements of Excellent graduates.[1]

Thus, although on average only slightly more than 100

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1. Excellent expanded gradually, at first merely overseeing the training aboard guardships in addition to its original duties, but in 1839 acquiring additional barracks at Portsmouth, and in 1851 the Edinburgh, 58, as a sea-going complement to Excellent. Trainees rose from 200 per year in the early thirties to 1100 per year in 1851. Douglas, 4th ed., pp. 14-22, 440. Adm.1/4032, Ordnance to Admiralty, 9 Nov. 1836.

gunners graduated from Excellent each year, it would appear that these graduates exercised an influence disproportionate to their actual number. The Admiralty were determined that this should be so: only first class candidates were accepted for the course, prize money was set aside for top graduates, and a further incentive was provided by offering a commission to the gunner passing out top in his class. After graduation seamen gunners were granted increases in pay ranging from two to seven shillings per month according to length of service, and Captain Hastings was granted the power to recruit instructors for periods of from five to seven years. The Admiralty insisted that the course work aboard Excellent be of the high order "absolutely necessary to sustain the Character of the Institution."[1]

The course open to officers was of a very high standard indeed - so high that Montagu Burrows, Chichele professor of Modern History at Oxford and a former naval officer, believed

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1. Ind. 5045: 59-4, 21 Dec. 1830. See also Ind. 5025: 59-4, 4 June 1830; 5038, 12, 13 April and 12, 16 Oct. 1832; 5053, 2 and 4 June 1834. Bartlett, pp. 41-42; Oliver, ed., "Excellent", pp. 20-30.

that only the most exceptional officers could turn to practical account the highly theoretical knowledge imparted. Few others benefitted, according to Burrows, from the study of differential and integral calculus, hydrostatics, hydrodynamics and optics to a level equivalent to that required for a degree at Cambridge.[1] To this impressive list were added theory and practice courses in steam engineering, mechanical drawing, fortifications and gunnery. Instruction was also given in the construction of rockets, fuzes and tubes. The training for seamen gunners was a more practical version of the same course and hence perhaps more appropriate. Men trained first as seamen gunners, went to the fleet, and returned to qualify in turn as gunners, gunners' mates and yeomen of the powder room.[2]

Montagu Burrows was not alone in viewing the practical

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1. Bartlett, pp. 319-23. P.H. Colomb, Memoires of Sir Astley Cooper Key (London, 1898), pp. 65-72.

2. Douglas, 4th ed., p. 16.

benefits of Excellent with some reservation. His belief that the officers' course was too theoretical was reinforced by Admiral Moresby's contention that the seamen graduates were overpaid lay-abouts, and that the course they had followed left something to be desired. Moresby thought that the lowest rating (3.3) required almost no knowledge of gunnery on the part of the candidate, that 1.1, the highest rating, was adequate, but that as the rating attained made little difference to future advancement there was no incentive to work for top grades.[1]

There would also appear to have been some dissatisfaction with Excellent among members of the Admiralty. According to J.H. Briggs, in 1835 the First Lord, De Grey, intervened when Admirals Beresford and Rowley dismissed a lieutenant's passing examination as "some of Tom Hastings' scientific bosh", and suggested that Hastings and the Excellent be dismissed as well. De Grey supposedly avoided the issue by stating that Parliament

1. Oliver, ed., pp. 28-30.

would not accept such a move. Apocryphal this story might be; nevertheless it is interesting to note that in the same year an Admiralty memorandum observed that long-range gunnery, one of the raisons d'être of Excellent, had not been proved superior to the traditional close-quarters action.[1]

The fact that very few opportunities arose during the period under study to prove or disprove the effect of long-range fire in action makes it difficult to assess the exact influence of Excellent on the gunnery of the day. Nevertheless her worth would appear to have been proved at Acre in 1840:

> ... if the gunnery of the ships had been inefficient this mistake of the enemy [they had fired too high] might have been rectified, but the very first broadsides were murderous and the smoke very shortly enveloped all of them, as there was very little wind. It is also a historical fact that for guns of that period in wooden ships, something like perfection had been attained.[2]

This, it should be pointed out, was written by Montagu

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1. Bartlett, pp. 41-42. Briggs, pp. 46-48. Adm.1/3486, memo, 13 July 1835.

2. Young, House that Jack Built, pp. 18-19.

Burrows who fought at Acre as battery officer on Edinburgh's lower deck, and who has already been cited as a critic of Excellent's standards. Burrows was not alone in attributing British success to good gunnery, and perhaps Acre, occuring at a time when Excellent's annual cost of £30,000 was troubling reactionary admirals and economy-minded politicians, did more than anything else to silence opposition to the gunnery ship. Certainly the Admiralty believed that their faith in such an establishment had been completely vindicated "by the brilliant success of the Fleet on the Coast of Syria."[1] And it was no doubt with Acre in mind that Minto, on quitting the Admiralty in 1841, expressed the hope that his successor would permit Excellent to continue her good work. No serious doubts arose as to the need for a gunnery ship following Acre.[2]

Graham's granting of regular establishment to Excellent in

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1. Ind. 12188: 59-4a, 24 Jan. 1841.
2. Adm.3/265, Minto memo. 6 Sept. 1841. See also Oliver, pp. 9-11; Young, pp. 18-19.

1832 coincided with his decision to reform the naval administration. He replaced the old semi-autonomous civil departments such as the Navy and Victualling Boards by five new departments, each under a permanent head, and each under the direct supervision of one of the Lords of the Admiralty. These reforms have been amply described in other works and need not be discussed here. What does pertain to this study is Graham's inquiry into the troubled nature of Admiralty-Ordnance relations, and the influence on these relations of the setting up of Excellent.[1]

The relationship between the Ad iralty and the Ordnance Department in 1832 was briefly this: by Order in Council of 10 July 1679, Ordnance was given the responsibility of supplying armaments to all the British forces, including the Royal Navy. In providing weapons for the navy, Ordnance was "bound to obey

1. Bartlett, pp. 8-12. Sir R. Vesey Hamilton, Naval Administrations (London, 1896), pp. 5-6, 15, 20-24. For other works praising or criticizing Graham's reforms, see Bartlett, p. 10, note 2.

equally the Lord Admiral and the Lord Treasurer", in respect of production and costs; and as for arming the forces in general, it soon became a cardinal rule that the navy should take priority over other forces.[1]

This arrangement did not always function smoothly, owing to the fact that the Ordnance Department had three responsibilities that could quite easily come into conflict with one another. The first responsibility was to furnish Admiralty requests for weapons; the second was to account to the Treasury for the expenditure involved; thirdly, Ordnance had at the same time to meet the insistent demands of all other military units for weapons.

Thus arose the unusual situation where the estimates for naval ordnance were carried in Vote 6 of the army estimates, while the administrative direction of these funds was in the

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1. Adm.7/677, "Establishments of Ordna ce", Order in Council of 10 July 1679. P.P. (1887), viii. 82I. For a broader view of Ordnance activities around this time, see Dupin, Military Force, I. 229-66.

hands of the Admiralty. Had there been close liaison between the two Boards, the difficulties inherent in the situation need not have been insuperable. Unfortunately what liaison there was, was at best sporadic, with the result that Ordnance submitted estimates without knowing the Admiralty's plans, while the Admiralty made plans without actually knowing what funds, or even what materials, were on hand at Woolwich with which to carry them out.[1]

Ordnance, to be sure, was able to predict Admiralty needs in a general way by reference to past expenditure, and indeed, even assessed the proportion of naval expense involved in running its various establishments. But the knowledge that the naval expenditure involved at the Chatham Ordnance Establishment was 7/8ths of the total, whereas that at Portsmouth was 5/6ths had little practical application. Ordnance paid the total in any case. Indeed, an 1887 Select Committee discovered that as a consequence of the "many administrative

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1. See Hamilton, Naval Administrations, pp. 79-81.

difficulties" involved when two boards shared one r sponsibility, neither had kept adequate accounts of the exp nditure on naval armaments, and that such items as gunpowder, small arms, locks and tubes, h d never even been recorded.[1]

The unusual financial arrangement between Admiralty and Ordnance occasionally resulted in bad feeling between the two Boards. For example, in 1835 the Admiralty grudgingly allowed their requisition for 60 8-inch shell guns to lapse when Ordnance claimed that the money for them could not be found. Again, in 1838 Admiralty patience was strained when Ordnance insisted that a cheaper, and in the Admiralty's opinion, an inferior and unsafe, mode of storing shells aboard ship be adopted. Other such examples of Ordnance's control of the purse strings h ving influence on the production of naval armaments could be cited. But on the whole they were minor affairs, more irritants than serious threats to the adequate arming of the navy. Much more serious was the complete absence

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1. P.P. (1887), viii.821-23. See also P.P. (1847-48), xxi. I. 670-77.

of cost figures for gunnery production and experiment.[1]

While the Ordnance De artment's financial control of armament production seldom affected dmiralty plans, its actual control of the means of production had a tremendous influence on the manufacture of naval armaments. For in carrying out Admiralty instructions it was the military men at Woolwich who drew up specifications and plans, decided whether the order in question was to be made up at Woolwich or at one of a number of private firms, and carried out experiments to determine whether the finished product met Ordnance Department standards. To these military men also belonged the responsibility for suggesting and testing innovations in naval weaponry. It was at this point that Admiralty-Ordnance relations were most liable to become strained.

The testing of all armament inventions was left to the

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1. Adm.1/4031, Ordnance to Admiralty, 7 Mar. 1835; 4034, 29 Sept., 28 Nov. and 21 Dec. 1838. Other instances of Ordnance financial influence are to be found in Adm.1/4026, Ordnance to Admiralty, 10 Jan. 1826; 4027, 8 Jan. 1828; 4029, 15 Dec. 1830 and 26 Jan. 1831; 4031, 23 April 1835.

Ordnance Select Committee, a group set up in 1805 under the presidency of the Director General of the Field Train and staffed in part by the heads of various Ordnance departments. These officers, together with the Colonels and Field Officers Committee, which had begun as two separate committees in 1765, comprised the Select Committee. Together they assessed all inventions and improvements by observation, discussion or trial, and reported their findings to the Board of Ordnance.[1]

Composed largely of elderly soldiers promoted to their ranks almost solely on the basis of seniority, the Select Committee tended on the whole to be cautious and not readily amenable to innovation. Thus it was this committee that frequently dissuaded the Admiralty from introducing shells and percussion powder into naval service. And it was the Select Committee, with their conservatism and internal division, who

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1. Hog , Royal Arsenal, II, 1432-33. In special cases the Master General of the Ordnance could appoint his own select committee to report directly to him. Dupin, Military Force, I. 249-52.

thwarted the Admiralty when that by no means revolutionary body decided to adopt Congreve's 24-pdr. medium ship gun in 1813.

It is not necessary to repeat in full the conflict that arose between Admiralty and Ordnance, and indeed within the Ordnance Department itself, over Congreve's new gun. Suffice it to say that this episode perhaps best exemplified Brigadier Hogg's observation that "the Royal Arsenal had always been prone to petty squabbling."[1] It also demonstrated the manner in which these purely internal conflicts at Ordnance could be reflected within the Select Committee, with serious repercussions on Admiralty planning. For although suggested in early 1813 for service against the Americans, production of Congreve guns was held up sufficiently to ensure that they never served their intended purpose. And the reports of the Select Committee illustrate brilliantly Brigadier Hogg's generalization that

> ... the Select Committee was hidebound, steeped in traditional methods, lacking in imagination and op osed to change. Another of its failings was

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1. Hogg, II. 735.

> its peculiar aptitude for secrecy and reserve, and its assumption of oracular wisdom.[1]

These characteristics did not ensure that the navy's specialized problems received sympathetic study. In the case of the Congreve gun, it will be recalled from Chapter One, the Select Committee would not admit that its successful testing was anything more than accidental. The marked prejudice of both the Committee and the Inspector of Artillery, Sir Thomas Blomefield, against the new configuration lay behind Ordnance's refusal to provide the Admiralty with Congreve guns. Ordnance's rebuke to the Admiralty's declaration that in naval matters Admiralty decisions had ultimate authority, again illustrates the delicate relationship obtaining between the two Boards:

> "I am directed to state that the Board of Ordnance are always ready to take upon themselves the responsibility which results from the exercise of that discretion vested in them by their public duty; and without commenting upon the terms in which the Communication of Their Lordships' sentiments is couched in your letter, or upon the

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1. Ibid. II. 1433.

> inadmissable and unprecedented tone of authority assumed in it, the Board desire to remark, with regard to the provision of these Guns, that it is not necessary for them to justify that measure to the Lords of the Admiralty, and that they receive orders from the Master General of the Ordnance only."[1]

Ultimately, of course, the Admiralty's contention was upheld, and Ordnance did, reluctantly, provide the desired guns. But the delay and acrimony involved in the procedure suggested that some alteration in the Admiralty-Ordnance relationship would be desirable.

In fact the only improvement that took place in the testing of naval ordnance came in 1819. In that year, Wellington, as Master General of the Ordnance, insisted that naval officers be attached to the Select Committee whenever equipment of interest to the navy was undergoing trials.[2] It was thus not surprising that, with the growing interest in gunnery and gunnery training

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1. Adm.1/4021, Ordnance to Admiralty, 18 Oct. 1813. See above Chapter One.
2. Adm.1/4024, Wellington to Admiralty, 30 Aug. 1819.

depots during the 1820's, attention was drawn to the fact that in the whole matter of gunnery the navy had practically no representation. Critics such as Bowles, Pechell and Sir Charles Napier pointed out that the Admiralty consisted largely of civilian personnel and contained no gunnery expert, while Ordnance had a predominance of military men and contained no naval expert. To this fact they attributed the profound lack of interest in gunnery on the part of many naval officers.[1]

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1. Bowles, pp. 81-82. Napier, The Navy, pp. 29-30, 44-45, 91-96. Pechell, pp. 12-14. See also Parkinson, Exmouth, p. 273, Between 1810 and 1835 only three naval officers served on the Board of Ordnance: Vice Admiral Sir Robert Moorsom as Surveyor-General, 1810-20; Rear Admiral Sir E.W.C.R. Owen in the same office 1827-28, and again as Clerk of Ordnance 1834-35; and Captain Sir Henry Duncan as Principal Storekeeper, 1831-34. P.P. (1837), xl. 253. In 1845, Peel, seeking to transform the sinecure of Principal Storekeeper into a strong link between the Admiralty and the Ordnance, appointed Sir Thomas Hastings. Hastings had been appointed to the Excellent by the Whigs in 1832. Peel wrote Sir George Murray, Master General, "I hope you will give me credit for this bit of political virtue." Add. MSS. 40570, Peel to Murray, 16 July 1845.

It is thus understandable that the whole question of Admiralty-Ordnance relations came under review in 1832, when Graham was initiating his administrative reforms, and when Excellent had become a new factor in this relationship. From 1833 to 1837 it was debated whether or not the navy should establish its own ordnance department. All members of the Ordnance, including the Inspectors of Artillery and of the Royal Carriage Department, together with Sir James Kempt and his successor as Master General, Sir R. Hussey Vivian, were again t such an expensive duplication of effort. Naval opinion, as expressed by Sir John Barrow and Captain George Elliot, Secretaries to the Admiralty, was in favour of the duplication. Captain Henry Duncan, one of the few naval officers to sit at Ordnance (he was Principal Storekeeper of the Ordnance from 1831 to 1834) saw the desirability of such a change but believed it would be much too expensive. A Select Committee report of 21 February 1837 therefore advised that no change be made in the Admiralty-Ordnance relationship, but that the matter come under periodical review. Not until 1891 did the Admiralty assume complete responsibility for its ordnance.[1]

For the period under study, therefore, the Ordnance Department exercised tremendous influence on the development of naval armaments. But the establishment of Excellent as both an experimental depot and a gunnery training ship, provided the navy with an unprecedented opportunity to study those armament problems peculiar to naval service. And although Ordnance, with its vastly superior laboratory and range facilities, contimued to dominate armament developments, the role of Excellent im the improvement of naval weaponry during the thirties and forties was enormous.

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1. P.P. (1887), viii. 94-95. Hamilton, pp. 81-83.

Chapter Six

THE EVOLUTION OF THE LAST GENERATION OF SMOOTH-BORE ORDNANCE, 1830-53

Throughout the eighteen thirties and forties continuous weapons trials were carried out at Portsmouth and Woolwich. And although lack of relevant documents makes difficult the t sk of assessing the contribution made to armaments development, either by Excellent or the Ordnance Department, sufficient information survives to indicate the nature of this development. The search for satisfactory guns to fulfill Melville's scheme of uniform calibre combined with shell guns occupied the greater part of the thirties. During the decennial review of naval armaments held in 1838-39 exhaustive artillery trials at Deal brought about the adoption of a new generation of smooth-bore ordnance, to ether with more scientifically precise windages, powder charges and range-tables. The increased numbers of paddle-wheel steamers throughout the forties, an increase attributable l rgely to British apprehension over France's renewed maritime vigour, resulted in the development of very heavy solid shot and shell guns for bow and stern armament. By 1853 cast iron naval guns had attained the greatest range and size compatible with safety and sea service, and smooth-bore ordnance had reached the peak of its development.

The period between 1830 and 1853 presents several problems to the historian seeking to describe the evolution of naval artillery. In the first place, there was no radical difference between naval guns in service as late as 1860 and those that had been in use three centuries earlier. Certain refinements had been made in, for example, the casting of the metal, more precise fitting of the projectiles to their bores, and gunpowder; but there had been no basic change in the principle of their construction. Therefore to define the many modifications and improvements made between 1830 and 1853 in guns that differed in no essential characteristic is no easy task.[1]

Another problem is the scant documentation of this period. For little of the correspondence between Admiralty and Ordnance from 1839 to 1850 survives, and what survives is often obscure. This obscurity can be attributed to two main causes: first, those reporting on experiments, either as members of the Ordnance Select Committee or as officers aboard H.M.S. Excellent, were experts addressing themselves to experts. They consequently felt little need to enter into minute detail on the subject of their report. If, for example, they were evaluating two similar guns, the report usually included little more than their respective ranges together with the committee's

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1. This writer has seen no information on the precise nature of the improvements in casting and mensuration in armaments manufacture. It is interesting to note in this respect, however, that it was in the 1830's that a true metal surface and the standard inch and foot were established, and that measurements to one ten-thousandth of an inch became possible. F.C. Lea, Sir Joseph Whitworth, a Pioneer of Mechanical Engineering (London, 1946), pp. 3-23.

recommendation as to which gun best answered the purpose intended. No analysis of the reasons for the difference in performance was attempted.

The security arrangements of the time also contributed to the obscurity of existing documents on mid-nineteenth century gunnery. For throughout the entire period under study, all major innovations in this field were studied and introduced in complete secrecy. Thus, instructions for fitting gunsights in 1824 were issued as secret orders, the Admiralty believing that "particular explanations of this nature should not be made generally public."[1] A similar secrecy surrounded the activities at Excellent from which the public, and especially foreign officers, were officially barred, and where great precautions were taken to keep the results of tests secret from the Press. To assist in keeping military secrets from the public and foreign powers, both Admiralty and Ordnance further insisted that no service personnel be trained in the manufacture and use

1. Adm.1/4025, Ordnance to Admiralty, 20 Jan. 1824, minute.

of "some of the Articles manufactured or arranged in the Laboratory ... if the nature of their Service does not absolutely require it."[1] This desire for secrecy thus explains to a considerable degree the lack of documents and the obscurity of those that survive.

But while these problems make difficult an absolutely thorough study of the improvement of armaments between 1830 and 1853, it is nevertheless possible to observe the significant improvements made in this period. Surviving documents are adequate to enumerate the nature of guns tested and adopted, to reveal the extensive experimentation and trial carried out at Woolwich, Portsmouth and Shoeburyness, and to demonstrate that, during the eighteen thirties, the many problems of smooth-bore ordnance were being solved.

Britain's first shell gun was the 50 cwt. 8-inch gun of

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1. Adm.1/4024, Wellington to Melville, private, 15 Feb. 1821. See also Adm.1/4033, Ordnance to Admiralty, 2 June 1837 and minute; Add. MSS. 41581, Sir Alexander Dickson to Lieutenant Colonel C.C. Dansey, 4 July 1839; Ind.5064: 59-4, 18 Feb. 1835, 5076; 59-4a, 21 and 23 July 1836; 12328: 59-4a, 1 Aug. 1850.

6 feet $8\frac{1}{2}$ inches designed by William Millar and tested aboard H.M.S. Northumberland in 1821. Somewhat later Millar designed a 10-inch shell gun, 9 feet 4 inches in length and weighing 84 cwt. In 1829 Melville ordered 10-inch guns for steamers under construction and allocated two 8-inch guns to each ship of the line. Graham's Board, succeeding that of Melville in 1830, agreed with these armament proposals but found certain practical difficulties in their implementation.[1]

It was soon discovered that the 50 cwt. gun had limited ranging power and was too short to throw its fire completely clear of the gun port. The 84 cwt. 10-inch gun, on the other hand, while having neither of these failings, was much too heavy for use in ships of the line. Experiments were immediately begun to test the feasibility of heavier 8-inch and lighter 10-inch guns. 10-inch guns of 57 and 62 cwt. proved to be failures, and the original 84 cwt. gun, first used on the steamers Dee and Rhadamanthus, continued to arm the heavier

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1. For Melville's policy see above Chapter Four.

classes of steamers well into the fifties.[1]

Better fortune attended the search for an adequate 8-inch weapon. The 50 cwt. version was soon displaced by three varieties of 60 cwt. 8-inch guns, and these in turn were, by 1834, found to be inferior to models 9 feet in length and wei hing 65 cwt. The 50 cwt. model was at first retained for frigate use, the 60 cwt. for 74's. By 1850 however, the 65 cwt. had become the most popular shell gun in the navy for "all rates and classes, for broadside batteries as well as for the pivot-guns of steamers."[2]

This search for the most suitable shell gun did not end until 1836. For this reason the decision of 1829, that each ship of the line be armed with two shell guns, was not fully carried out. The two 10-inch guns aboard Talavera since 1829 were not, in fact, fully tested until 1831; and it was not until

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1. Adm.1/4030, Ordnance to Admiralty, 23 Jan. and 22 May 1833; 4031, 29 Oct. 1834 and minute.

2. Douglas, 4th ed., p. 198. See also Adm.1/4031, Ordnance to Admiralty, 7 Mar. and 30 Dec. 1835; 4032, 29 Jan., 8 April, 30 July and 30 Sept. 1836.

the following year that the Admiralty ordered that "such a proportion of dead shells and fuses as may be necessary, should be issued to every ship having on board 68-pdr. carronades or Major Millar's large guns."[1] It is unlikely that such an issue of shells took place, for not until 1834 was any apparent effort made to provide ships of the line with shell guns and shell rooms. In that year the 104-gun ships Camperdown, Impregnable, Princess Charlotte, Queen Charlotte and Royal Adelaide were prepared to receive six 68-pdr. guns or carronades.[2]

In February 1835 the Admiralty were still uncertain as to the dimensions these shell guns should have. To determine this point seven models numbering 76 guns in all underwent trials at Woolwich, on Excellent, and aboard the steamers

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1. Adm.1/4030, Ordnance to Admiralty, 29 Oct. 1832. See also Adm.1/4029, Ordnance to Admiralty, 4 Mar. 1831, enclosure, and 9 May 1831; 1687, Captain David Colby of the Talavera to Admiralty, 12 April 1831.

2. Adm.1/4031, Ordnance to Admiralty, 4 March 1834. Production of the 68-pdr. carronade was discontinued in the same year. Ibid. 17 Dec. 1834 and minute.

Phoenix and *Medea* at sea. At the close of 1838, the Royal Navy still had only 167 shell guns on hand, and of these only 30 were aboard ships in commission. Nevertheless, the two models of shell gun that were to provide the mainstay of the Royal Navy until the sixties, the 65 cwt. 8-inch and the 84 cwt. 10-inch guns, had been settled upon.[1]

The solid shot armament that emerged by 1838 also differed considerably from that planned for by Melville in 1829-30. Melville had ordered four different weights of 32 pdr. - 63, 56, 48 and 25 cwt. - for ships of the line and frigates. The 63 cwt. version soon proved to be much too heavy for extensive broadside armament, the 205 cast serving only as solid shot armament in large steamers. The three remaining models continued in production, but the number required was so enormous that it soon became apparent, not only that foundries

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1. Adm.1/4031, Ordnance to Admiralty, 17 Feb. 1835, enclosure. There were 20 shell guns abo rd first- and second-rates, 4 on third and fifth-rates, and 6 on steamers. Adm.1/4034, Ordnance to Admiralty, 14 Nov. and 21 Dec. 1838, enclosures.

mi ht not have sufficient productive capacity, but that Parliament would be reluctant to pa for them in a period of economic austerity and at a time when the advent of shell guns threatened large broadside armaments with extinction. Under these circumstances the Admiralty decided to achieve 32-pdr. uniform calibre as cheaply as possible. The simplest way to accomplish this aim was to ream out 24-pdr. guns to fire 32-pdr. projectiles.[1]

This expedient had been used successfully in 1817 when at the suggestion of Sir Howard Douglas, carronades were bored up to the diameter possessed by guns of equal calibre. The success of this measure indicated that guns as wll as carronades could be given enlarged bores without dangerously weakening them, and this was shown to be the case in 1831, when 6 ft. 6 in. 24-pdrs. bored up to 32-pdrs. withstood the full proving charge without bursting. In 1835 the policy of boring up be n in earnest when Congreve 24-pdrs. as well as

1. Adm.1/3489, me o. of William B. Dundas, Inspector of Artillery, undated, 1839.

certain patterns of 12- and 18-pdrs. were bored up to the next, a d in som cases the second higher calibre. By 1837 1,152 guns had been bored up, 911 of them to 32-pdrs., d in 1838 over 3000 24-pdrs. and 492 18-pdrs. awaited the drill at Woolwich.[1]

Not one of these guns had burst by 1839, indicating that the fears expressed over the safety of bore-ups had been groundless. The navy therefore had a cheap and ready supply of 32-pdrs. with which to attain the desired uniform calibre; moreover, no extensive alterations, such as those made in ships of the line in 1826-28, were necessary: with bore-ups, most British ships could deliver 32-pdr. broadsides, while retaining the same armament weight as had been carried when they mounted 18- and 24-pdrs. Yet another advantage of these guns was that a reduction in windage gave them a range and

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1. Adm.1/4029, Ordnance to Admiralty, 25 July 1831, minute; 4031, 18 Mar., 15 and 20 July, 14 Dec. 1 35; 4033, 11 April and 7 Nov. 1837; 4034, 7 Feb. 1838; 4035, 15 April 1839. See also Douglas, 1st ed., pp. 71-72, 91-95; 3rd ed., pp. 123-25.

penetration, often with reduced charges, superior to that possessed by 24-pdrs.[1]

The bored up 32-pdr. nevertheless h d grave shortcomings. Superior though it was to its old self, it was decidedly inferior to the regulation 32-pdr., not only in range and penetration, but in stability: for when what was basically a light 24-pdr. gun fired a heavy 32-pdr. shot, the recoil was often sufficiently violent to break the breechings, smash the carriage and sometimes maim the crew, as well as to propel the shot wildly from the bore.[2] Moreover, although the navy adopted uniform calibre more quickly by employing bore-ups, it is doubtful whether there was much of a gain in terms of efficiency over the old multi-calibred system. For while the guns were indeed 32-pdrs. there were in fact three sizes of bore, 6.30 inches, 6.35 and 6.41 inches, requiring three

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1. Windage was the term applied to the difference in diameter between shot and bore. See above Chapter Two.

2. Douglas, 3rd ed., pp. 206-12. Simmons, Present Armam nt, pp. 5-6, 18.

sizes of shot hardly distinguishable one from the other if windage was to be constant. These three dimensions of bore greatly increased the difficulties confronting Excellent in her attempt to establish valid range tables, difficulties aggravated by the necessity to provide for 10 models of 32-pdr. rather than the four envisaged in 1829-30, each model requiring its particular charge and elevation to attain a given range.[1]

By December 1838 ships in commission were almost entirely armed with 32-pdrs., there being only 38 24-pdrs. mounted in ships of the line.[2] Nevertheless, the standardization implied was, for the reasons noted above, illusory. As early as 1835 the Ordnance Department was complaining that

> ... although the ships of His Majesty's Navy
> are classed, it is not found that any two
> ships of any one class (except that of 10 guns)

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1. In addition to the 25, 48, 56 and 63 cwt. models envisaged by Melville, there emerged ones of 32, 39, 40, 41, 43, 48 and 50 cwt. Adm.1/4034, Ordnance to Admiralty, 7 Feb. and 10 Aug. 1838. Neither France or America used bore-ups to any extent. Douglas, 3rd ed., pp. 206-07.

2. Adm.1/4034, Ordnance to Admiralty, 21 Dec. 1832, enclosure.

> are armed with ordnance of the same nature, which occasions a considerable variation as to the powder and ammunition allowed....[1]

To difficulties of supply were added problems in gunnery. It could have taken years to compile range-tables for this hodge-podge of 32-pdrs., and without these tables the valuable work of Excellent in providing trained gunners was wasted. It is not surprising, therefore, that in 1838 a new series of 32-pdr. was brought forward for trial.

These guns were designed by Mr. T.B. Monk, a civilian worker at the Royal Arsenal, on the lines of the controversial Congreve 24-pdr. of 1813. This entailed strengthening the breech around the charge by a redistribution of the metal from the barrel. Monk's A-type 32-pdr., 9 feet 6 inches in length and weighing 50 cwt., proved to be a most efficient gun. Although 6 inches shorter and 6 cwt. lighter than the regulation 32-pdr., it was thicker around the cylinder of the charge than the 56 cwt. gun, and propelled its shot as far with

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1. Adm.1/4031, Ordnance to Admiralty, 2 Mar. 1835.

an 8 pound charge as the larger gun did with a 10 pound charge. B and C-type guns, 8 feet 6 inches 45 cwt. and 8 feet 40 cwt. proved equally efficient and, by 1850, 4279 of the three patterns had come into service to replace the bore-ups.[1]

Between 1830 and 1838 the British had evolved, in a leisurely fashion, most of the gun models that were to represent the last generation of smooth-bore naval ordnance; for Monk's 32-pdrs., together with the 8-inch and 10-inch shell guns, were to serve in ships of the line and steamers until well after the introduction of rifled ordnance. But if the development of these guns had been somewhat tardy, their introduction into service after 1838 was accomplished with considerable urgency. The two major reasons behind this

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1. Douglas, 4th ed., 193-95. Ind.12264: 59-4a, 21 Mar. 1846. This writer has been unable to locate any information on Monk, apart from the fact that he was employed for an unspecified time at Woolwich. There is some indication that as a civilian he was badly treated by both Admiralty and Ordnance, and never given credit for having designed these guns. See W. Greener, <u>Gunnery in 1858</u> (London, 1858), pp. 73-74.

sudden vigour were the decennial review of the state of the navy and increasing world tension.

During the decennial review, usually undertaken during the last two years of the decade, Admiralty and Ordnance assessed weapons and equipment in service, studied and experimented with new equipment, and determined the innovations to be made during the next ten years. Thus the decision to introduce Congreve 24-pdrs., gunsights and vent tubes, taken in 1818-19, was gradually carried out during the eighteen twenties. Similarly, Melville's decision of 1828-29 to adopt war steamers, shell guns and 32-pdr. uniform calibre, and to set up a gunnery school at Portsmouth was, broadly speaking, implemented during the thirties, although satisfactory guns for the program were not forthcoming until 1838. In July of that year the third decennial review of the century commenced with experimentation on "recent and improved contrivances in gunnery." Improved gunsights and fuzes, percussion tubes and locks, together with a variety of lesser "contrivances" were studied, tested and in turn recommended or rejected for service. The opportunity was also taken to finalize plans for the storing and handling of shells in ships of the line.[1]

The review of 1838-39 undertook more ambitious projects than the study of innovations in materiel. In 1838 experiments commenced at Excellent to assist in preparing range-tables for all heavy ordnance. These experiments were continued on a larger scale in 1839 when the Ordnance Department, assisted by the Admiralty, drew up a program for exhaustive artillery trials. In April of that year Lieutenant Colonel Charles Cornwallis Dansey, R.A., was appointed by the Master General of the Ordnance "to superintend and carry into effect certain practice and experiments with h avy ordnance at a station near Deal, to determine

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1. Adm.1/4034, Ordnance to Admiralty, 17 July 1838, enclosure. It was finally decided that shells should be issued filled and with the fuzes in place, stored in boxes on shelves in a special room amidships and beneath the water line. See Adm.1/4030, Ordnance to Admiralty, 29 Oct. 1832; 4032, 2 June and 12 Aug. 1836; 4034, 29 Sept., 1, 5, 10 Oct., 28 Nov. 1838; 4035, 2, 7, 28 Jan., 26 Mar. and 15 July 1839.

questions of infinite importance to the Service of Artillery by sea and land."[1]

Between May and November continuous trials were carried out on 13 types of heavy naval ordnance and 14 varieties of powder; more than 2600 rounds of all descriptions of shot and shell were fired to determine the range and effect of each. The results of these trials were to confirm the earlier choice of the 8-inch 65 cwt. gun and the Monk 32-pdrs. for general armament purposes, to establish the windage for the latter at .175 inches, and

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1. Add. MSS. 41581, Sir Alexander Dickson, Deputy Adjutant General of Artillery, to Dansey, 5 April 1839. Dansey had served in most Peninsular actions, and had been severely wounded both at Burgos and Waterloo. In 1828 Dickson pushed hard to h ve Dansey appointed Major of a rocket batallion, and he served as Chief Firemaster at the Royal Laboratory from 1839 until 1846. W.H. Askwith, <u>List of Officers of th Royal Regiment of Artillery from the Year 1716 to the Year 1899</u> (London, 4th ed., 1900), p. 241. See also Add. MSS. 41580, Dickson to Hardinge, 17 ug. 1828.

to provide range-tables for each nature of gun tested.[1]

In ordinary circumstances the Admiralty would have accepted these decisions, and in a leisurely fashion set about issuing orders to have the recommended innovations gradually adopted by the service. This is what had happened during the thirties, with the result that shell guns and uniform calibre were so gradually and so imperfectly attained that in 1838 the navy possessed few shell guns and only an approximation to uniform calibre. But during the early thirties there had been little need to rush the adoption of new and expensive armaments, for the simple reason that no other power appeared ready to do so, and no other power seriously threatened the

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1. Correspondence relating to the Deal trials and largely between Dickson and Dansey is to be found in Add. MSS. 41581, fos. 10-135. See also Adm.1/4035, Ordnance to Admiralty, 10 and 21 June, 8 and 26 July, 9 and 26 Dec. 1839. The range-tables are given in Douglas, 3rd ed., Appendix A, tables I-V. On percussion at this time see W.O.44/500, packet entitled "Inventions: percussion locks and tubes 1835-42."

peace.[1] Britain took advantage of these peaceful years to patiently and thoroughly seek the most satisfactory weapons before committing herself to the great expense of a complete re-armament. Having attained these weapons by 1838, and tested them in 1839, she was able to provide them quickly during the tense years of the eighteen forties.

In the late 1830's Britain faced mounting tensions in various parts of the world. Rebellion in Canada, piracy in the Far East and tension in Latin America were only preludes to a serious deterioration in relations with both France and Russia. In 1839 Britain was alarmed at France's renewed military and naval confidence demonstrated against Algiers in 1837, and Mexico in March 1838, and even more alarmed by

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1. Mutual Anglo-French suspicions between 1830 and 1832 appear to have had little influence on naval armament schemes. As has already been described, the shell guns installed in Talavera in 1829 were not properly tested until 1831, and no great urgency was shown in this respect until 1839. That the French showed a similar lack of activity is evident from Dupin, Organisation de la Marine, I. 276-82.

Russia's renewed threat to the Dardanelles. By December 1839, with the greater part of Britain's fleet in dockyard for repair, or committed to trouble spots throughout the world, the commissioned force in home waters amounted to only eight brigs, a deficiency that contributed as much to the panic that gripped the British Parliament and public between 1838 and 1841 as any fear of what France and Russia might do. Professor Bartlett's able assessment of the naval side of this confusing period permits only the briefest reference to it; what is more germaine to this work is the impetus given to armaments activity by international tension, coinciding as it did with the decennial review of 1838-39.[1]

Although Britons feared an attack by the capable Russian Baltic fleet in the autumn of 1838, the preparations then made by Admiralty and Ordnance would appear to have been carried out more with the hereditary enemy, France, in mind. For it was France's renewed maritime vigour, particularly in the Mediterranean, that made her, rather than America, the power to

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1. See Bartlett, pp. 116-47.

watch for armament development throughout the thirties.[1] France h d cautiously led the way in introducing uniform calibre and shell guns in the twenties; durin the thirties her determination to learn the lessons of past defeats put her well ahead of other powers in the scientific pursuit of gunnery perfection. To the School of Naval Instruction set up at Brest in 1830 was added the publication Tactique in 1832, as well as a squadron of exercise, all with the purpose of providing excellent instruction for a new generation of naval officers. In 1833 a corps of Marine Artillery on the British model was established to provide 500 picked gunners annually, and four years later additional schools of artillery were set up at Brest and Toulon, complete with gunnery frigates for practice at sea. In June 1834 the Conseil des Travaux, a

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1. The Americans did not adopt uniform 32-pdr. calibre until 1845, nor a gunnery training ship until the early fifties. In 1838, when the Canadian Rebellions were still taking place, Palmerston was assured that the American Navy presented little threat. Dahlgren, Shell Guns, preface, p. 13, pp. 23-25. Bartlett, p. 121, note 4.

body created in 1831 and composed of naval officers, constructors and artillerists, initiated an exhaustive three-year series of artillery experiments at Gavres and Metz which included tests of all types of weapons and projectiles in service against armoured and unarmoured targets. Finally, by a Regulation of April 1838, French first-rates were to receive 34 30-pdr. shell guns on their upper decks, and four of the powerful Paixhans guns of 80 on their lower decks. All these activities, to ether with the openly expressed conviction of a growing number of Frenchmen that their fleet was second to none, including that of Britain, was not lost upon the Admiralty and some members of the cabinet.[1]

The Admiralty had already determined on the 65 cwt. 8-inch shell gun and in February of that year had ordered the immediate production of 100. But the French decision to use 30-pdr. shell

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1. Bartlett, p. 118. Baxter, pp. 28-29. Douglas, 4th ed., 232-33. H. Busk, The Navies of the World; Their Present State and Future Capabilities (London, 1859), pp. 34-35. R. Jouan, Histoire de la Marine Française (Paris, 1950), pp. 275-78. ELL/218, Palmerston to Minto, 2 Nov. 1838.

guns came as a surprise. It was not until autumn, however, after the beginning of the decennial review in July, and in the midst of the panic over the expected arrival of the Baltic Fleet, that the Admiralty took firm measures.

In September and October range tests were held with 8-inch and 6-inch 32-pdr. shells at Southsea, and against the hulk Prince George at Portsmouth. It was soon apparent that little progress had been made in increasing the accuracy of shells, or in preventing their tendency to burst prematurely or to be snuffed out on ricochet. Thus, of 32 8-inch shells fired in ricochet, five burst prematurely while others were extinguished, and at 400 yards ten out of eleven 32-pdr. solid shot found the mark as compared with only three out of eleven 8-inch shells. Better accuracy was attained with the 32-pdr. shell, a projectile that also served well as shot should it fail to explode. Despite what appeared to be disappointing results the

Admiralty ordered 10,000 8-inch and 5,000 32-pdr. shells.[1]

It was not until 21 January 1839 that the final draft of the Admiralty's plan for the new armament was published. To comply with the specifications laid out in this document, every ship in commission, down to and including the first class sixth-rate of 26 guns, was to carry between two and twelve shell guns. First-rates of 104- and 120-guns were to mount four 8-inch guns of 65 cwt. on the lower deck and a further two on the middle deck, while 110-gun vessels were ordered to carry six on the lower and four on the middle decks. Second-rates were to be equipped with eight, ten or twelve, third-rates and large frigates with either four or six. The small 38-, 42- and 44-gun fifth-rate frigates each received two 8-inch guns of 60 or 52 cwt., and four 52 cwt. guns were

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1.Adm.1/4034, Ordnance to Admiralty, 27 Aug., 18 and 24 Sept., 29 and 31 Oct. 1838; 4035, 30 Jan. 1835; 3498, Inspector of Artillery and Director of the Royal Laboratory to Ordnance, 4 Oct. 1838. See also Douglas, 3rd ed., pp. 281-86, 291-92; Admiralty publication Experiments in H.M.S. "Excellent" 1832-54 (London, 1854), pp. 6-14.

assigned to each 36-gun frigate. Smaller vessels were to set aside two 32-pdrs. as shell guns and the proportion of shells was fixed throughout the fleet as 40 filled shells per shell gun.[1]

Solid shot armament was to consist of the three sizes of Monk 32-pdr. together with either the 25 cwt. Dickson gun or 17 cwt. carronade. As it happened, supplies of the Monk gun were so limited that the Admiralty had to resort to using the old 32-pdrs. Thus, for a considerable period great dependence was placed on the 56 and 48 cwt. guns, and the Congreve and Blomefield 24-pdrs. served until well into the fifties as bored up 32-pdrs.

The lack of documents from 1839 to the end of the period under study, makes it impossible to determine with any accuracy the extent to which the armament proposals of 1839 were carried

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1. See Adm.1/3498, bound correspondence entitled "Guns of heavy calibre and shells proposed to be introduced into the fleet". It is dated 21 Jan. 1839, but contains correspondence of various dates and sources.

out. The order of 1839 was directed to the entire fleet in commission, and provision was also made in it for casting the necessary weapons for ships of the ordinary between 1840 and 1842. At the same time it is possible that the navy was slow to receive its new weapons, a possibility that would appear to be enhanced by the fact that in 1850 many Congreve bore-ups were still in service, while only 4,000 Monk 32-pdrs. had been cast. The rate of supply of shell guns is unknown, but it is instructive to note that in 1841 Minto was convinced that the proportion of shell guns in ships of the line should be increased, and that such an increase did take place in 1849, when second-rates of the Rodney and Albion classes had their allocation doubled from 12 to 26.[1]

It would appear that the proportion of shell guns to solid shot guns in ships of the line was never satisfactorily worked out. As Dahlgren wrote in 1850, this question perplexed naval

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1. Adm.3/265, Minto memo. 6 Sept. 1841. Douglas, 4th ed., pp. 601-07. See also ELL/252/A, "Papers on Gunnery, 1838-40."

authorities in all countries owing to the fact that there were no fleet actions to indicate what the effects of the new armament would be, or whether large numbers of shell guns were necessary to destroy the enemy.[1] In any case by the 1850's the question had become largely academic, for while large sailing ships with screw propulsion continued to be provided and armed with 32-pdrs., the dominant interest was in large shot and shell guns. It was this interest in large guns that was to end cast iron smooth-bore ordnance, and to eventually determine the shape of fighting ships.

The history of the development of the British war steamer, from Melville's reluctant acquiescence to its use in 1830, through paddle-wheel and screw-assisted sailing vessels to the armoured Warrior, had been told many times; only the briefest of outlines is necessary here, indicating the armaments of the larger steamers and the profound effect that the use of steamers had on the evolution of naval artillery. In 1830 the Royal Navy had three armed steamers in commission; by 1835 their number had increased to twenty, and five years later there was a total of forty such

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1. Dahlgren, Shell Guns, p. 221.

vessels. A vigorous building policy in 1846 resulted in 86 steamers afloat the following year, a figure that had dropped by ten in 1850. All of these steamers, with a few exceptions such as the experimental Rattler and Blenheim, had once common feature: they were driven by paddle-wheel.[1]

The inability of paddle-wheel steamers to mount cannon

1.P.P. (1850), xxxv. 452-55. Excellent general works on steam are Bartlett, pp. 196-235, 283-91, 323-36; Brodie, pp. 23-75. On armour see Baxter, passim. On propulsion see G.S. Graham, "The Transition from Paddle-wheel to Screw Propeller", M.M. xliv. 35-48. The Admiralty, and especially the Royal Arsenal, both extremely well-informed on armament developments in the most modest of navies, must have been aware of experiments with armour plate carried out in France and America. Nevertheless there is no indication that, apart from one brief trial in 1842, such tests were held in England until 1852. The large guns that were developed in the forties were therefore not adopted for purposes having to do with armour. They were adopted primarily to meet the special conditions imposed by paddle-wheel steamers, and secondarily to retain the range advantage of solid shot over the large shell guns mounted at sea and in coastal fortifications. For experiments against iron plates and iron ships in the forties, see Experiments in "Excellent", pp. 26-54. The invasion panics of the forties aroused interest in arming coastal batteries and merchant steamers with guns equal to those carried by war steamers, thereby increasing the demand for heavy guns. Add. MSS. 40445, fos. 192-201, 40508, fos. 100-3, 40457, fos. 211-13. Bartlett, pp. 235-49.

other than fore and aft, was to have a profound influence on naval ordnance. For not only were paddle-wheels and their bulky machinery extremely vulnerable under enemy fire, but they also rendered extensive broadside armaments impossible. In consequence of this limitation, guns tended to be few in number but large in size and power.[1] It is not possible, owing to the dearth of relevant documents, and to the tendency to experiment with a variety of guns on the same steamers, to give the exact armament of individual steamers throughout their service. Nevertheless the general pattern of armament is quite clear.

The earliest, larger class of steamer such as the 800 ton vessels _Dee_, _Salamander_, _Phoenix_ and _Medea_ were, in 1831, carrying one 10-inch gun aft, and a heavy 32-pdr. "elsewhere". _Medea_, and later _Thunderer_, had their armament doubled to two 10-inch guns and two 32-pdrs. at bow and stern, an arrangement that remained in favour throughout the thirties and forties, although occasional variations took place for the purpose of

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1. See Robertson, pp. 231-34.

experiment and trial.[1] It was the "extraordinary effects of live shells" from Gorgon's two 10-inch bow guns that proved so successful against the entrenched positions of the Carlists near San Sebastian in May of 1837, and that encouraged a more vigorous program of steamer construction in 1838.[2] This program in turn contributed to France's decision in 1839 to construct ten armed mail steamers suitable for war purposes, a move that drove Britain to a more ambitious building policy than the Admiralty considered wise in the light of the many technological problems that continued to plague war steamers.

Throughout the forties war steamers increased in number, size, horse-power, and strength of armaments. Nevertheless, the largest steam-frigates could mount only a fraction of the guns carried by the sailing frigates and ships of the line they were coming to approximate in size. Thus the Terrible, a paddle steam-frigate launched at Deptford in 1845, weighed

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1. Adm.1/4031, Ordnance to Admiralty, 17 Feb. 1835. See also Ind. 5031; 59-4, 26 May 1831; 5038, 3, 4, 5 and 10 Oct. 1832; 5045, 21 Dec. 1833; 5053, 3 and 27 Jan. 1834.

2. Douglas, 3rd ed., p. 284, note.

1,850 tons, was 226 feet long, and was expected to mount only 28 heavy guns. With her machinery installed, it was discovered that she settled too low in the water when carrying more than 16. Simil r problems of flotation do ged smaller steam-frigates such as the Penelope, Retribution and Leoperd, and the five classes of steam-sloop that emerged could mount only three or six guns.[1]

The severe restriction on the number of guns that a paddle-wheel steamer could carry lead to an intense interest in large, solid shot guns that could be fired at high elevations to attain range, while at the same time remaining sufficiently mobile to permit the widest possible arc of fire through pivoting. This interest had first been demonstrated at Deal in 1839, when particular attention had been paid to the effects of 42- and 56-pdr. guns cast by Monk on the same principle as his 32-pdrs. Monk had originally intended these guns for

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1. Sir Alan Moore, Sailing Ships of War 1800-1860 including the Transition to Steam (London, 1926), pp. 51, 54, 61. See also Brodie, pp. 42-43.

coastal defense, and such was to be their ultimate role. But so great was their battering power and range that inquiries were soon launched as to the feasibility of mounting them on steamers for use against shell guns at sea or against coastal fortifications.

On May 16 1842 the Admiralty informed Ordnance that several very large steamers were soon to be built and that it would be desirable to renew trials at Deal on all large guns to determine their range, power and suitability for such vessels. In addition to Monk's 56-pdr. of 91 cwt., 42-pdrs, of 84 and 75 cwt, and 32-pdrs. of 63 cwt. were tried. Also tested at Deal were 68-pdr. solid shot guns of 90, 95, 110 and 112 cwt. and the formidable 11-ton 130-pdr. prepared for the Pasha of Egypt. These very heavy guns had in fact little or no advantage in range over the more manageable 56-pdr. which ranged 4087 ards at 15 degrees of elevation and 5720 yards at 32 degrees. None of the other guns was tried at the second elevation, apart from the 32-pdr. of which there was a considerable supply. This gun ranged 4860 yards at 32 degrees before it burst.[1]

The result of these trials which were carried out between 1842 and 1846, was that the 8-inch 65 cwt. was retained as the most common shell gun for sailing vessels, but became more widely used aboard steamers; the 10-inch gun, given a heavier breech that increased its weight from 84 to 86 cwt., remained the most popular steamer armament. As this gun could be elevated only 15 degrees, with a range some 2,000 yards less than the 56-pdr., solid shot 56-pdrs. were consequently introduced for a time to several of the larger class of steamers such as Terrible, but soon gave way to the more powerful and only slightly heavier 68-pdr. pivot guns of 95 cwt.[2]

The heavy guns developed during the thirties and forties to meet the special requirements of paddle-wheel steamers were

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1. Adm.1/5519, Admiralty to Ordnance, 16 May 1842. Douglas, 4th ed., pp. 188-96. See also Ind. 12188: 59-4a, 17 May, 7, 9, and 21 Dec. 1841; 12216, 28 Feb. and 6 Mar. 1843; 12232, 10 and 18 Dec. 1844.

2. Ind. 12264: 59-4a, 6 and 20 May, 3 July 1844; 12312, 27 Jan. 1849.

almost double the weight of the largest broadside ordnance. Yet the recoil of these massive weapons had to be confined to very limited deck space, and the guns themselves subjected to elevations 5 to 6 times those of broadside cannon. Slide carriages were soon produced with screw compressors to retain recoil, and elevating screws to provide the necessary elevating controls, while designed to permit pivoting the gun.[1] But it

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1. Robertson, Chapter Six, is devoted to gun carriages. While satisfactory on earlier truck carriages it is less so for heavy-gun mounts in steamers. Douglas credits William Millar, the inventor of England's shell guns, with providing suitable carriages. They apparently consisted of a slide with grooves along which the gun recoiled, the recoil being taken up by friction that could be increased by tightening "compressor" wing-nuts on the chocks. Although the slide did not itself recoil, it was fixed to the deck by bolts at front and rear, bolts that could be fitted to a number of different bolt-holes in the deck, thus permitting slide and gun to pivot through a wide arc. Douglas, 4th ed., pp. 203-06. Thomas Hardy did invent a "compressor-plate" type of carriage as described in Robertson, but as the plates were found to rust stuck it never progressed beyond the trial stage. Ind. 12174: 59-4a, 29 Aug. 1840; 12188, 13 Jan. 1841. For the plan of a carriage similar to those of Millar see W.O.44/500, Select Committee Report, 1 Nov. 1838, enclosure.

was soon discovered that large guns fired at long-range and under sharp recoil control became strained and liable to burst. Thus the 63 cwt. 32-pdrs. that could fire at 6 degrees of elevation indefinitely, burst at Deal in 1839 on the sixtieth round at 32 degrees, and at the same elevation at Shoeburyne s in 1852, a 10-inch gun burst on the fifty-fourth round.[1]

The tendency of large guns to burst during long-range firing was believed to be the result of additional "lateral pressures" attending high elevation recoil. Thus at 6 degrees elevation the gun recoiled more or less horizontally, and in free and direct reaction to the fli ht of the projectile; at 32 degrees, on the other hand, the gun was entirely out of the horizontal so that it recoiled downward upon the comparatively unyielding carriage and deck. The force of the recoil was therefore only partially translated by the carriage with the result that the sides of the gun absorbed a much greater

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1. W.O.44/502, Ca tain H.D. Ch ds of Excellent to Admiralty, 7 Oct. 1852. Douglas, 4th ed., p. 192.

proportion of this force than was normal, "shaking and disintegrating the crystelline [sic] structure of the metal" in such a way as to cause the gun to fracture.[1]

But "monster guns", as cannon above the 32-pdr. were called, were prone to bursting at moderate elevations as well. High elevation firing merely accentuated the inherent weakness of cast iron for heavy ordnance. Basic to this weakness was the fact that it was almost impossible to achieve the necessary homogeneity of metals cast in such large moulds, and it was equally difficult to ensure uniform cooling of the mould. Further, when the barrel exceeded a certain thickness, it was impossible to secure the proper distribution of intense heat and great force caused by the explosion in the chamber; the resulting disparity in interior and exterior barrel temperature, together with the unequal distribution of force, produced strains sufficient to rupture the guns.[2]

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1. Greener, Gunnery, pp. 88-89.
2. Ibid. 87-89, 101-04. Brodie, p. 184.

It was this weakness in cast iron that gave impetus to the search for stronger metals for gun construction. Wrought iron, an early alternative metal, proved stronger than cast iron, but it was equally difficult to form homogeneously, and in addition was highly expensive. The idea of shrinking a wrou ht iron envelope over a cast iron barrel, first suggested in France, was tried in 1843 when Professor Daniel Treadwell of Harvard University built a small number of guns on this "built up" principle for the American Government. A more elaborate and successful application of the same principle was to be made after the Crimean War, when William Armstrong used it in constructing his first rifled guns. During the forties, however, there was little British activity in this respect, apart from a demonstrated willingness to inspect and test the wrought iron or rifled ordnance of Cavalli, Wahrendorff and Norton. In any case, the disasterous explosions of wrou ht iron ordnance abroad, notably that of Stockton's "Peacemaker" aboard U.S.S. President in 1844, damped the enthusiasm for different metals until after Crimea.[1]

The naval armaments decided upon during the decennial review of 1848-49 remained, therefore, roughly those adopted in 1839. Sailing ships continued to mount 32-pdrs. and between two and twelve 8-inch guns, with the exceptions of the Albion and Rodney classes of second-rate, which were to carry 26 8-inch guns, and a number of 42- and 46-gun frigates "reduced" to 19 and 20 guns, just under half being 8-inch and 56-pdrs. All guns, with the exception of those of 10-inch, were supplied with both shot and shell, and a very destructive 32-pdr. shot and shell combination had been issued to all ships since 1847. Every ship was thus capable of fighting any style of sea-battle that was envisioned in 1850, whether it be at long- or close-range, with solid shot or shell, against ships or coastal

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1. Brodie, 193-97. On these guns, none of which was successful, see Douglas, 3rd ed., pp. 245-53. Norton's rifled 1-pdr. shell was first tried in 1832, when it was un ble to hit a target at 100 yards. Adm.1/601, Select Committee Report, 9 Feb. 1832.

fortifications.[1]

The armament schemes of 1839 and 1849 had been adopted with the French in mind as the potential enemy. In the early fifties fear of France continued to dictate the n ture of British artillery experiments, with the result that in late 1852 heavy naval guns were tested at Excellent with the sole purpose of determining their usefulness in bombarding French coastal batteries with impunity. The guns under trial were a 10-inch with its weight increased from 86 cwt. to 116 cwt. to strengthen the breech and sides sufficiently to permit high-elevation firing, and the 95 cwt. 68-pdr.

At 32 degrees elevation the 10-inch gun projected 100-pound shells 5,860 yards, and at the same elevation and using "eccentric" solid shot, the 68-pdr. ranged 6500 yards. For

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1. W.O.44/501, Captain Chads to Ordnance, 13 ug. 1847, Select Committee report to Ordnance, 6 Oct., and Admiralty to Ordnance, 30 Oct. 1847. Douglas, 4th ed., Appendix F, pp. 601-07. In 1846 Captain Hastings pr nounced the shell system "as safe in use as shot." Add. MSS. 41581, Hastings to Lord Cl rence P get, 14 Dec. 1846.

smooth-bore ordnance these ranges were unprecedented and satisfied the Admiralty that French coastal batteries could be destroyed from the sea. As a result of these trials every large steamer, whether propelled by screw or paddle-wheel, received at least one heavy 68-pdr., generally in the form of a pivot gun mounted in the bow.[1]

The 95 cwt. gun was the last smooth-bore heavy cannon to be used extensively in British naval armaments; for larger cast iron ordnance could not reasonably be constructed with due regard to safety and the requirements of naval service. Of _Warrior_'s original 40 guns, 36 were of this nature, and loaded with steel shot, 68-pdrs. remained the favourite armour-piercing gun until well into the sixties when muzzle-loading rifled guns, constructed on a different principle and

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1. W.O.44/502, packet entitled "Experiments with eccentric shot and shells". See especially Captain Chads to Admiralty, confidential, 7 Oct. and 23 Dec. 1852. Eccentric shot and shell were, on the suggestion of Sir Howard Douglas, deliberately cast with the center of gravity above the center of the projectile. When pl ced in the gun with the wei hted segment up a sizeable increment in range resulted.

of new metals, began to surpass them in range and penetration.[1]

In August 1853 a naval review was held at Spithead. Of the forty participating warships only three were without some form of steam propulsion. Screw-assisted ships of the line and frigates predominated. These warships and their armaments represented a happy synthesis of tradition and innovation, combining as they did the strategic advantages of sail with the tactical advantages of steam, crushing broadside batteries with long-range pivot guns, solid shot with shell. These warships considerably enhanced Britain's ability to conduct the type of global warfare she had experienced during the past hundred years. They were to be less useful in the special conditions of the Crimea. The vulnerability of wooden ships in action to shell fire was to be at last effectively demonstrated at Sinope and

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1. See Brodie, pp. 181-98. For a description of the armaments used in the first ironclads, smooth-bore, Armstrong rifles, and muzzle-loading rifles, see O. Parkes, British Battleships 1860-1960 (London, 1966), pp. 5, 7-9, 12-15, 18-19, 25-28, 32.

before the formidable Russian batteries. Before the end of the war both Britain and France were experimenting with ironclad floating batteries and rifled artillery. The era of the ironclad battleship was at hand.

CONCLUSION

Between the years 1815 and 1853, the smooth-bore ordnance that had served sailing navies from their earliest days, was brought to its fullest development. And if the 8-inch, 10-inch and 32-pdr. guns of 1853 differed in no essential principle from the 12-, 18-, 24- and 32-pdrs. of 1815, they were in every way superior. More skilfully designed, more strongly cast, and with more scientifically determined powder charges and windages, the last generation of smooth-bore ordnance was vastly superior in range and penetration to the models used by Nelson. Moreover, operated by highly trained crews in accordance with accurate range-tables and strict gunnery instructions, the later artillery was much more effective with shot or shell, at close- or long-range, against ships or coastal fortifications. By 1853 cast iron naval guns had attained the greatest power and weight compatible with safety and sea service, and smooth-bore ordnance and smooth-bore gunnery had been brought to something like perfection.

These developments in naval armaments, infinitesimal perhaps compared with those of the second half of the nineteenth century, were nevertheless remarkable. All the more remarkable was the fact that they were introduced following two centuries of negligible progress in naval armaments, and in years of peace and economic depression when military expenditures were hotly debated in Parliament. For many of these years, too, the navy's traditional popularity was dimmed by the more recent victories of Wellington's armies. Under these unlikely conditions the nineteenth century naval armaments race commenced.

What were the influences that prevailed against these considerable restraints on naval development? What were the major innovations in naval gunnery after 1815? And, not less important, what was the Admiralty's attitude to these innovations, and the policy followed in adopting them?

Britain's quickening interest in armaments development immediately after the war resulted directly from her comparative lack of success against the Americans in the War of 1812. The close-range, rapid-fire tactics, brilliantly successful against

European navies, failed against the long-guns and long-range skills of the Americans. The Americans had demonstrated that heavy artillery used in conjunction with sighting aids and intensive gunnery training, provided reasonable accuracy at long-range, and maximum fire-power at close-range.

Notwithstanding the overwhelming supremacy of the Royal Navy in 1815, the Admiralty correctly anticipated that other navies would follow the American example. Gunsights and vent tubes were introduced to improve the accuracy of the guns, and gunnery manuals and gunnery training to improve the skill of the crews. Nor was the need for heavier artillery overlooked. By 1817 24-pdrs. were the lightest guns carried in the main batteries of ships of the line, although the Americans had already moved up to the 32-pdr. and a few years later added 42-pdrs. to the lower decks of their largest ships. In 1824 France introduced uniform 30-pdr. calibre, thus leaving Britain with by far the lightest broadside strength of the three navies. In 1826, therefore, the Royal Navy began to receive 32-pdr. uniform calibre. These rapid increments in broadside weight brought the sailing ship of the line mounting solid shot ordnance to the height of its efficiency and power.

America did not again influence naval developments to any appreciable extent until the time of the Civil War. Nevertheless, the heavier solid shot armaments she inspired were directly, if only in part, responsible for the introduction of shell guns into naval service. Paixhans in France had studied these increasingly heavy armaments, and the larger and more expensive ships necessary to carry them. He believed that one shell exploding at the waterline of such a ship would sink it. He further believed that by mounting shell guns in war steamers, France would bring about a revolution in naval architecture that would force ritain to abandon her sailing fleet in order to compete on equal terms with French steamers. By 1829 shell guns mounted on war steamers had demonstrated their value for warlike purposes, and the Admiralty ordered both introduced into service.

Shells did not at once cause the revolution predicted by Paixhans. They did, however, create an immedi te need for highly skilled gunners who could fire this complex projectile safely and accurately. The failure of the Royal Marine Artillery to train such men, a failure revealed at Navarino in 1827, lead the Admiralty to establish a gunnery training school and experimental depot aboard H.M.S. Excellent at Portsmouth on the model suggested by Sir Howard Douglas in 1817. The navy thus assumed responsibility for training its gunners, and Excellent provided unprecedented facilities for the study of armament problems peculiar to naval service.

Between 1830 and 1853, continuous experimentation and trial at Portsmouth and Woolwich brought forth better gunsights, new percussion locks, accurate range-tables and improved powder ch rges. A new generation of smooth-bore ordnance was also developed during these years; and although 32-pdrs. remained the standard broadside armament, increasingly h avy and more powerful artillery was provided to meet the special needs of paddle-wheel steamers. By 1853 both 32-pdrs. and 8-inch pivot guns were capable of firing shot or shell, and cast iron naval ordnance had attained the greatest size and power compatible with safety and sea service.

The greater part of the artillery developments that occurred between 1815 and 1853, including those th t took place following the establishment of Excellent, were carried out by the Ordnance Department, the department responsible for providing and financing weapons for all the British services. It is thus hardly surprising that misunderstandings and delays occasionally occurred in a situation where one department developed and paid for armaments used by another department. For the most part, however, the arrangement worked well enough, and the Admiralty was not only able to make its own suggestions and decisions, but had authority over Ordnance in naval matters, although that authority required great tact in its exercise. Thus if much of the machinery for armament development was not in Admiralty hands, the ultimate responsibility for policy was.

The Admiralty's policy was simply to adopt nothing of importance until forced to do so by armaments developments in foreign navies. So long as Britain's naval supremacy could be maintained with the weapons at hand, it would have been absurd to herself undertake the considerable effort and great expense to render them obsolete. Thus it was th t such major innovations of the p riod under study as gunsights and gunnery training, uniform calibre and shell guns, were adopted by the Royal avy only after France or America had forced their adoption. By keeping careful watch on the activities of foreign powers, by holding con tant and secret trials on a small scale both at Woolwich and aboard ships at sea, and by reviewing all gunnery equipment every ten years, the Royal Navy was never in danger of falling behind other powers in armaments development.

To impatient inventors and visionaries who saw little of this unceasing activity, Admiralty policy a peared to consist of nothing more than a violent prejudice against pro ress. Prejudice there undoubtedly was, both at the Admiralty and among naval officers. But there is every reason to believe that, on the Ad iralty's part at least, a very real sense of duty ultimately prevail d over any "retrograde proclivities" when innovation could no longer be safely avoided.

Indeed, where rearmament on a major scale was concerned, there was a very real danger that new weapons might be adopted too soon, rather than too late. A striking example of such impetuosity occurred in 1828-29, when those supposedly staunch reactionaries, Melville and his First Sea Lord, Cockburn, introduced war steamers and shell guns, uniform calibre and percussion locks, and ordered that no more ships of the line be built. It was left to Melville's successor, Graham, to point out that steamers could not yet fulfill most of the functions of a warship, and to discover that the locks and most of the gun models selected by his predecessor were unsatisfactory. By quickly reverting to the traditional Admiralty policy of cautious trial and gradual introduction of new armaments, Graham was able to keep the losses on unserviceable equipment to a minimum. Suitable weapons for Melville's farsighted but premature armament scheme were not forthcoming for another decade.

Admiralty conservativism was thus not based to any appreciable extent on abhorrence of innovation. Conservativism was inherent in a policy that had as its major aim the protection of Britain's immense financial investment in her existing fleet. Given the facts of Britain's naval supremacy and unrivaled technological and industrial resources, and taking into consideration her attentiveness to foreign developments and her willingness to experiment with new materiel, this was not an unreasonable policy. In a period of economic depression and unprecedented armaments development, it was a very sensible policy.

Appendices

Appendix A

Naval Guns in Service in 1813, 1832, and 1848

Table I

Naval Guns in Service in 1813

Nature		Length Ft.	ins.	Weight cwt.
Guns	32-pdrs.	9	6	55
	24-pdrs.	9	6	50
		9	0	47
		6	6	33
		6	0	31
	18-pdrs.	9	0	42
		8	0	37
		6	0	27
	12-pdrs.	9	0	34
		8	6	33
		7	6	29
	9-pdrs.	8	6	29
		7	6	26
		7	0	25
	6-pdrs.	8	6	23
		8	0	22
		7	6	21
		7	0	20
		6	6	18
		6	0	17
Carronades	68-pdrs.	5	4	36
	42-pdrs.	4	6	22
	32-pdrs.	4	0	17
	24-pdrs.	3	9	13
	18-pdrs.	3	4	10
	12-pdrs.	2	8	6
Mortars	13-inch.			101
	10-inch.			52

W.O.44/498, Royal Arsenal to Ordnance, 29 Mar. 1813, enclosure.

Table II

Naval Guns in Service in 1832

Nature		Length Ft. ins.		Weight cwt.
Guns	32-pdrs.	9	7	63
		9	6	56
		8	0	48
		7	6	40
		6	6	32
		6	0	25
		5	4	
	24-pdrs.	9	6	50
		9	0	48
		7	6	40
		6	6	33
	18-pdrs.	9	0	42
		8	0	38
	12-pdrs.	9	0	34
		7	6	29
	9-pdrs.	7	6	26
	6-pdrs.	6	0	17
Carronades	68-pdrs.	8	0	60
		6	8	50
	68-pdrs.	5	4	36
	42-pdrs.	4	6	22
	32-pdrs.	4	0	17
	24-pdrs.	3	9	13
	18-pdrs.	3	4	10
	12-pdrs.	2	8	6
Guns for hollow shot	12-inch.	8	4	90
	10-inch.	9	4	84
	10-inch.	8	4	62
	10-inch.	7	6	57
Mortars.	13-inch.			
	10-inch.			

Adm.1/4030, Ordnance to Admiralty, 29 June 1832, enclosure.

Table III

Naval Guns in Service in 1850

Nature		Length Ft. ins.	Weight cwt.
Iron:	68-pdrs.	10 0 9 6	95 88
	56-pdrs.	11 0 10 0	98 87
	42-pdrs.	9 6	67
	10-inch.	9 4 9 4	86 84
	8-inch.	9 0 8 10 8 0	65 60 52
Guns	32-pdrs.	9 6 9 6 9 6 8 0 8 0 7 6 7 6 6 6 6 0	61½ 58 56 48-50 41 39 40 32 25
	32-pdrs.	9 0 8 6 8 0	50 45 42
	18-pdrs.	7 0 6 0 5 6	22 20 15

Table III - cont'd

Naval Guns in Service in 1850

Nature		Length Ft. ins.	Weight cwt.
Iron:			
Carronades	68-pdrs.	5 4	63
	42-pdrs.	4 6	22
	32-pdrs.	4 0	17
	24-pdrs.	3 9	13
	18-pdrs.	3 4	10
	12-pdrs.	2 8	6
	6 -pdrs.	2 9	4¾
Mortars	13-inch.	4 5	101
	10-inch.	3 9½	52
Brass:			
Guns	9-pdrs.	6 0	13½
	6-pdrs.	5 0	6
Howitzers	24-pdrs.	4 8½	13
	12-pdrs.	4 7 3 9¼	10 6¼

Douglas, Naval Gunnery, 3rd ed., pp. 581-82.

Appendix B

Prospectus compiled by Sir S.J. Pechell from Douglas's _Naval Gunnery_ for the establishment of _Excellent_ as a gunnery Training School

From Douglas, _Naval Gunnery_,
3rd ed., pp. 592-97.

Their Lordships having had under their consideration the propriety and expediency of establishing a permament corps of seamen to act as Captains of Guns, as well as a depôt for the instruction of the officers and seamen of His Majesty's Navy in the theory and practice of Naval Gunnery, at which a uniform system shall be observed and communicated throughout the Navy, have directed, with a view to the formation of such Establishment, that a proportion of intelligent, young, and active seamen shall be engaged for five or seven years, renewable at their expiration, with an increase of pay attached to each consecutive re-engagement, from which the important situation of Master Gunners, Gunners' Mates, and Yeomen of the Powder-room shall hereafter be selected, to instruct the officers and seamen on board such ships as they may be appointed to, in the various duties at the guns, in consideration of which they will be allowed 2s. per month, in addition to any other ratin they may be deemed qualified to fill, and will be advanced according to merit and the degree of attention paid to their duty, which, if zealously performed, will entitle them to aspire to the important situations before mentioned, as well as that of Boatswain.

Their Lordships have therefore directed the Excellent, with her present fittings (already placed in a situation where practice may be carried on with shot without risk of injury to any individuals), to be established as a 6th rate, with a complement of 200 men, and appointed Captain . . . . to the command of her.

The following instructions are sent for your guidance and that of Captain . . . . in the execution of these duties:-

	Complement	Boys of Second class
Captain . . .	1	
Lieutenants . .	4	
Surgeon . . .	1	
Purser . . .	1	
Assistant-Surgeon .	1	
Midshipmen . .	15	
Clerk . . .	1	
Warrant officers .	3	
Ship's cook . .	1	
Cook's mate . .	1	
Carpenter's crew .	2	
Armourer . . .	1	
Purser's steward .	1	
Sick-boy . . .	1	
Captain's servants .	2	1
Gun-room ditto . .	2	4
Midshipmen's berth .	2	1
arrant officers' ditto	.	3
Purser's steward .	.	1
Marines . . .	34	
Seamen gunners . .	116	
	190	10

As in the establishment of the officers and crew of the Excellent, a Lieutenant, three non-commissioned officers, and two privates of the Marine Artillery are included in her complement of Marines, it is intended that the theoretical instruction required for the officers a d seamen gunners should be furnished by them, and you will take care th t every facility and assistance be given them to insure the performance of this duty, the most material points of which are the names of the different parts of a gun and carriage, the dispart in terms of lineal magnitude and in degrees, how taken, what constitutes point blank and what line of metal range, windage, the errors and loss of force attending it, the importance of preserving shot from rust, the theory of the most material effects of different charges of powder applied to practice, with a sin le shot, also with a plurality of balls, showing how these affect accuracy, penetration, and splinters; to qualify them to judge of the condition of gunpowder by ins ection; to ascertain its quality by the ordinary tests and trials, as well as by actual proof, these being very indispensable qualifications; to instruct them also in the laboratory works required for the n val service, such as making rockets for signals, filling tubes, new priming them and filling cartridges, precautions in airing and drying powder, care and inspection of locks, choice of flints, correct mode of fitting them, &c., &c.

You are to understand that it is the intention of their Lordships that the Gunners from his Majesty's ships in ordinary, and also from the ships in commission when they can be spared, should asse ble on board the Excellent, in divisions of such numbers as the Commander may deem convenient, to carry on (assisted by the Marine Artillery already embarked in h r) the fullest experiments as to the power and ranges of the various natures of sea ordnance from point blank to the highest elevation the ports of the Excellent will admit of (or as may be safely tried without danger of the shot reaching the shore beyond the mud banks), also the ranges at similar elevations with different reduced charges of powder, likewise the difference in the ranges when two shots are introduced instead of one, and in such cases to observe and note down the apparent divergence of both shots from the direct line. Also, if it can be tried with safety, the range and force of grape and canister shot; and, in short, every experiment of such description which will tend to give the gunners and others who may attend such practice the most perfect knowledge of the exact powers of each nature of gun in every manner in which it can be tried.

To facilitate these experiments their Lordships consider that Beacons may be fixed in the mud at different measured distances from the ship, say at every hundred or every two hundred yards, or at such other distances as may be found most convenient.

At the same time that the above-mentioned experiments are going forward it will be the duty of the Captain, and of the Lieutenants to assist him, to endeavour to ascertain the comparative value of the several descriptions of sights for cannon which have been submitted by various individuals, some of every kind of which the Board of Ordnance has been desired to cause to be put on board the *Excellent*.

It is also their Lordships' intention that the efficiency of the improved tube boxes, powder flasks, and all other implements of every description connected with sea gunnery practice, should be proved, as far as may be done, on board the *Excellent*, and Captain . . . . is to consider it an important part of his duty to report impartially his opinion on all the implements in question, and to submit for their Lordships' consideration any alteration of any of them deemed likely to prove advantageous by himself or any of the officers assisting him in conducting the duties hereby ordered.

The Captain is also to make known to their Lordships any improvements he may have been informed of, either in guns themselves, or in the mode of mounting, or fitting or fighting them, or of the implements for serving them, which may not have been furnished by the Ordnance Department to the *Excellent*, in order that they may cause them to be also supplied for trial and report.

Another material branch of the duty of Captain . . . . will be to perfect the gunners and all others who may attend on board the Excellent for that purpose, in the established exercise or service of the guns, to the end that each of them may fully understand and be able to explain the object of every movement ordered; that they may likewise understand perfectly the principle of the sights, moveable targets, and everything used in gun practice, either for exercise or real service.

All these points, after being fully considered and tried in the various exercises and practice to be daily carried forward, are to be fully reported upon to their Lordships, in order that they may give directions for the general adoption of that system which shall be found and admitted upon full and fair trial to answer best in practice.

It is further to be understood that any ships in commission, the Captains of which are desirous of sending any portion of their officers, captains of guns, or others of their crews, to attend the practice or exercise on board the Excellent, to gain instruction on any of the points detailed, are to be at liberty to do so, and it is to be an essential part of the duty of Captain . . . . and the Lieutenants to give every useful information to persons so sent for instruction, and to advance them on the points most useful for them to understand, to such extent as the short time they can probably be spared will admit.

Their Lordships have requested the Board of Ordnance to give instructions to their officers to render every assistance in forwarding the objects of these instructions, and to supply such quantities of ammunition or other articles as may from time to time be required by Captain . . . . and approved by you for the purposes above detailed.

Captain . . . . is to be assisted in conducting these duties by the officer of Marine Artillery to the utmost of his abilities, and the latter officer is to be directed to obey whatever directions he may receive from Captain . . . . or the Lieutenants for the objects stated whilst on this service.

Their Lordships desire that you send a copy of this letter to Captain . . . ., that he may be fully apprised of the duties he is to execute, directing him to govern himself and those placed under him accordingly. And you are also to give such further directions and assistance as you may deem necessary or advisable for the more perfect accomplishment of the objects explained; and you are to cause Captain . . . . to make a weekly return to you of each day's transactions and practice, noting the number and descriptions of persons attending on board each day; to which also is to be added any remarks the Captain may deem it right to offer relative to the occurrences or details, and these weekly returns are to be regularly transmitted by you to me for their Lordships' information.

Appendix C

Succession of Inspectors, Superintendents, etc.
of the Manufacturing Departments, Royal Arsenal.

Royal Gun Factory* - Inspector of Artillery

Sir Thomas Blomefield, 5 Mar. 1780

Sir Alexander Dickson, 9 Sept. 1822

William Millar, 22 April, 1827

Sir Joseph Maclean, 1 May 1838

William B. Dundas, 1 Oct. 1839

James A. Chalmer, 1 April 1852.

Royal Carriage Factory - Inspector

Edward Fage, Jan. 1803

George Scott, April 1805

William Cuppage, 1 April 1806

Sir John May, 10 Nov. 1832.

Richard J. Lacy, 20 Oct. 1841

Henry W. Gordon, 16 Nov. 1844

James N. Colquohoun, 1 April 1852

Alexander Tulloh, 18 Sept. 1853

Royal Laboratory - Comptroller**

Sir William Congreve, Bart., 1783.

Sir Wm. Congreve, 2nd Bart., 18 June 1814

* Formerly Royal Gun Foundry.

** The title of Comptroller of the Royal Laboratory was changed in 1828 to Director, and in 1855 to Superintendent of the Royal Laboratory.

<u>Royal Laboratory</u> - Sir Augustus Frazer, 29 May 1828
Steven G. Adye, 15 June 1835
James P. Cockburn, 19 Oct. 1838
Richard Hardinge, 1 Jan. 1847
William Cator, 1 April 1852
John Wilson, 19 Aug. 1852
Edward M. Boxer, 14 June 1855

This list is taken from General W.H. Askwith, *List of Officers of the Royal Regiment of Artillery from the Year 1716 to the Year 1899* (4th ed. London, 1900), p. 170.

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Not only the Admiralty records and papers, but those of the War Office, could be explored indefinitely for information on naval armaments. The Admiralty digests, massive folio volumes containing listings of the in-letters of the Secretary of the Admiralty, and the directions of the Board concerning them, help to locate pertinent correspondence. The numerical headings for categories under which this correspondence is arranged in the digests, are found in Digests, Heads and Sections. From this the researcher can locate the proper digest or index number from Digests and Indexes, Series III (Adm.12), which in turn lists the correspondence under the department concerned. The index for each year between 1815 and 1853 has been consulted under the appropriate headings for gunnery (59 - 1) and artillery development and experiment (59 - 4, and 59 - 4a after 1835), and shells and explosives (98 - 22). Where the documents referred to under these headings are missing, the index reference has been cited in my footnotes.

In addition to the indexes, which lead to information on naval armaments contained in every category of Admiralty correspondence, several volumes of collected correspondence were of especial importance. Adm.1/4020-35, containing the Secretary's in-letters from the Ordnance Department between 1812 and 1839 were most helpful.

Other volumes of interest in the Admiralty's correspondence were: Adm.1/3356-57, letters from officers of the Royal Marine Artillery, 1821-31; Adm.2/1213-46, letters to officers of the

R.M.A. 1815-41; Adm.3/261-5, special minutes of the Board of Admiralty. Much of value is to be found under miscellaneous headings, notably Adm.7/577, 595, 615, 677, 709 and 712. Of less importance are Adm.95/86, the Steam Register of 1848; Adm.106/3061-66, correspondence of the Navy Board on armaments, 1780-1832; Adm.160/150-56, Proportion Tables, 1781-1853.

Volumes consulted in War Office correspondence, especially that of the Ordnance Department, were: W.O.44/498-502, Admiralty letters to the Secretary of the Board of Ordnance, 1812-53; W.O.44/641-44, similar letters from the Royal Laboratory, 1810-55. As was the case with Admiralty documents, volumes of more or less miscellaneous correspondence were helpful, notably W.O.54/936, 938, 881, 882, and W.O.55/307, 308, 1818, 1823, 1835 and 1875. Supply 5/31, confidential in- and out-letters of the Superintendent of the Royal Laboratory, 1833-34, provided an all too brief glimpse of the careful scrutiny kept on foreign armaments developments, and of the highly secretive manner in which experiment was carried out on new developments at Woolwich. Information on the career of Sir Howard Douglas has been found in W.O.1/261-63 and 254-56, in-letters of the Secretary for War from Douglas and Wellington; W.O.133/13 Brownrigg papers; W.O. 99/5-10, Minute Books of the Supreme Board of the Royal Military College, 1803-20.

II. British Museum

Private papers almost invariably held little of interest on naval armaments, but the following have been of some use:

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38265-68, Liverpool.
37878, 89, Windham.
39998, a manuscript on naval gunnery, 1835, by C. Dickson.
40022-29, Napier; some correspondence on gunnery.
40406-07, 40443-61, 40473, 40544, 40570, Peel; Some correspondence of interest with Hastings of Excellent, and with Sir Howard Douglas, and considerable interest shown in coastal fortifications and armaments for merchant steamers in the 1840's.
41394-406, Byam Martin; essential for 1815-30.
41580-81, Dansey; of particular value in connection with the armaments trials at Deal in 1839. Helpful for the 1840's.

III. National Maritime Museum, Greenwich.

ELL/214-24, 230-39, etc. Minto; helpful for the late 1830's, but only 252 A, a very slim folio, directly relates to Armaments.
MEL/109 Melville, disappointing.

Use was also made of the private papers of Sir William Parker and Sir Robert Stopford.

IV. National Library of Scotland.

MSS. 15, 1044-5, 3835, Melville; disappointing.
MSS. 2427-28, Cochrane; little of value.

Considerable correspondence of Sir Howard Douglas to a number of people, including Melville, is to be found here, but, again, it seldom deals with naval topics.

V. Royal Military Academy, Sandhurst.

R.M.A.S./I-VII, LeMarchant's letter books of 1804-11. Of considerable interest for Douglas's early years there.

VI

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